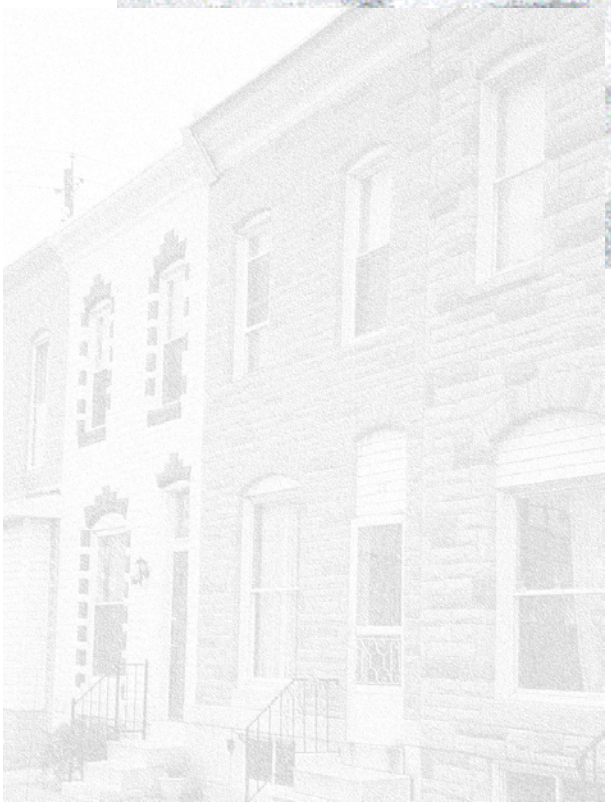
GREEN BUILDING TEMPLATE

A Guide to Sustainable Design Renovating for Baltimore Rowhouses



Prepared by:

TerraLogos: ECO Architecture

for

The Maryland Department of Natural Resources

December 2001

GREEN BUILDING TEMPLATE

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Introduction

There is now tremendous interest in giving new life to inner city homes through rehabilitation and non-structural renovation by many non-profit and for-profit builders, CDC's, private developers and homeowners. Significant cost savings, enhanced value and lower energy use and utility bills may be achieved if these homes are rebuilt using green building practices and incorporating energy efficiency improvements. These benefits may accrue all around: in savings to homeowners, to the community, in lower costs to the builder, and to the state and city in lower energy use and resource conservation.

Green building has many positive benefits and impacts. Green buildings use only 2/3 of the energy and 1/2 the water of comparable standard construction. They use 20% less materials, 40% more recycled components, and send 35% less construction and demolition waste to the landfill. By saving energy, green buildings produce 30% less global warming emissions (from coal-burning power plants), use 40% less ozone depleting refrigerants in the heating and cooling equipment, and save approximately $500/yr per person by having better indoor air quality. Green buildings, built with durability in mind, typically have lower maintenance requirements and a longer useful life. These benefits translate to a 10% to 15% better expected resale value.

The Green Building Template lays the foundation for future renovation projects by creating a replicable, adaptable framework. Its success depends on an integrated, holistic study, since building systems are highly interconnected. The process involves asking the right questions early, helping to set priorities, and giving the design team the tools to follow through and synthesize solutions.

Working with representatives from the Maryland Department of Natural Resources (DNR) and the Maryland Energy Administration (MEA), the project team developed the Green Building Template for the renovation of typical Baltimore City rowhouses. The template establishes a standard set of options that can be incorporated affordably to achieve the following:

- Improve the energy efficiency of the homes
- Provide excellent Indoor Air Quality and a healthy home environment
- Make recommendations for standard resource conservation measures (such as water or building materials)
- Study the potential for on-site construction and demolition waste recycling, use of recycled building materials and lower the overall waste stream loading caused by the renovations
- Provide local resource information for recommended materials and/or equipment

The options were established to work within the parameters of affordable, low to moderate income housing, on generally inner city or urban infill sites with short construction schedules. Two parallel case studies were used to develop the Template, working with the Patterson Park Community Development Corporation (PP-CDC) and the Middle East Community Development Corporation (ME-CDC). The Template addresses the range of options for a full “gut” rehab, and is applicable to moderate rehab as well.

The four primary professionals for this project are architects Julie Gabrielli, AIA and Kim Schaefer, AIA; building science and energy-efficiency consultant Bion Howard; and Tim Duke of Southway Builders, Inc., who did the cost analysis. Regular participants from Middle East CDC were Lucille Gorham, Michelle Brown, and Don Norwood. From Patterson Park CDC, participants were Heather Stauffer, Jim Shetler, and Ed Rutkowski. The MEA was represented by Charles Miller and Dale Baxter. Mark Bundy and Mike Li participated from DNR. David Brosch, of the Housing Authority of Baltimore (HABC), attended the 18 September meeting.

Section 1 Existing Conditions Analysis

The project team in conjunction with the Middle East CDC and Patterson Park CDC of Baltimore, Maryland are looking at ways to improve the performance, health and energy efficiency of typical Baltimore rowhouses that are scheduled for complete renovation or upgrades and energy system rehabilitation. We used the 24 N. Kenwood Avenue house currently under renovation by Patterson Park-CDC for our gut renovation example and the 830 N. Charles Street unit for a typical rehabilitation and lead abatement project by Middle East CDC. Please see Appendix A for plans, specifications and photographs of the sample properties used in this edition of the Green Building Template.

The houses generally date to the early 1900's and are quite narrow (12'-8" to 14' 0" wide to the center of the party wall property lines). Each home has approximately 600 square feet per floor and a full, generally unfinished basement. Both example projects are two story plus basement located mid-block. In considering energy use and performance of the building envelope in both the Patterson Park and in Middle East units, the houses have very little area exposed to the elements, at least compared to a single-family house. The houses either have the short end facing directly north-south or east-west. The front and rear walls account for approximately 660 square feet, and the roof, of around 600 square feet, make up the exposed area. The end walls are primarily brick with approximately 22% to 26% of the wall surface being glazed windows or doors. Two thirds of the basement is below grade; the upper third of the wall has as large a window as can be accommodated.

Unless they have been previously renovated, the homes have one large bathroom and two bedrooms upstairs and an open Living, and Dining Area and a Kitchen on the first floor. Narrow wood stairs, often as a single run, stack on top of one another for access to the basement and second floors. Some units have direct access through a small stair from the backyard to the basement. The homes have 9'-0" high ceilings, with operable glass transoms above the interior doors. Entrance doors are narrow measuring a clear opening width of 30 to 32". This may cause some problems if adapting the homes for wheelchair accessibility.

Three story homes are not uncommon in this area of Baltimore. Some of the blocks can be quite long, with 20 to 25 units on one side of the street. Most houses back up to alleys, which are sometimes wide enough to accommodate parking one vehicle, although the alleys are usually used only for service and trash pick up. Most houses have a very small rear yard that is concreted over and is separated from adjacent properties with a low chain link fence containing a gate to the alley. The GBT did not evaluate an end unit house, which would have more windows, or a three-story home, which may present better opportunities for the introduction of additional natural daylight.

The case study houses have the classic "Baltimore marble stoop" – three to four marble steps leading to the front door with a wrought iron handrail. People often hang out on the stoop. Some units have one-story, covered porch across the entire front of the house, which would significantly alter the energy performance of the house. The GBT did not analyze a unit with a front or rear covered porch. There are very few street trees for the houses we observed although there are deep front sidewalks with curb and gutter construction at the street edge. Dr. Mark Bundy of the Maryland Dept. of Natural Resources noted that many trees died in the early 1950's or were removed due to problems maintaining trees on urban streets. Many homeowners complained that the autumn leaves permanently stained the marble stoops and that falling branches could damage cars.

1A Construction of Existing Houses:

- Masonry load bearing exterior end walls and party walls, with brick veneer on front and stucco, siding or brick veneer on rear
- Small rear porches often enclosed and of poor construction
- Wood framing for floors and roof assemblies
- Single pane, wood windows that have often been reduced in size from their original installation, wood doors with divided light
- Wood strip floors, and wood tread stairs, generally in poor condition but often salvageable
- 2x_ tongue and groove decking on floors and roof assemblies
- Interior finish of 3-coat plaster on wood or metal lath directly on masonry or wood joists for walls and ceilings.
- No exterior wall insulation or vapor barriers and no "drainable" (weeped) cavity in the exterior walls

- Concrete “mud slab” (or topping slab) in basement, basement ususally low but occupiable, open tread wood stair inside to basement between first floor and basement
- Single run wood stair, narrow (30”) connecting floors (Some units may have winding type stairs in a Stair Hall)
- Unvented, very shallow attic (non-usable), Fascia vents often blocked.
- “Flat” low slope roof, built up asphalt, dark color
- Wood or metal front cornice, rarely have dormers, generally no parapets
- Replacement aluminum downspouts and gutters draining to splash-block in rear yard. If in good condition, not replaced.
- Ceramic tile in bathrooms with CT wainscot on all four walls
- Operable or vented skylight at top of stairs or in bathroom
- One bath, 2 bedrooms, living room, dining area, kitchen, basement
- Front stoop of traditional marble with wrought iron railing
- Small rear yard on alley, no garages or parking in alleys.

Often a molded cement face called “Formstone” was applied to the front wall’s face brick in the 1950's and 1960's. PP-CDC generally removes this material and repairs damage to the brick or re-points it, as necessary. A new interior stud wall with a 4” insulation batt is installed behind the front and rear exterior walls. Often the wood trim in the homes is old and substantial, probably of a hardwood but has been severely painted over with many coats. PP-CDC often will salvage wood trim and interior doors for re-installation into the rehab or for use in another property. If the wood trim remains, it is re-painted. Some homes still have a tiny front door vestibule that is generally removed by the CDC during renovation.

Most of the rehabs entail the replacement of the entire heating, cooling and ventilating systems for the homes. Middle East CDC often replaces only parts of the mechanical system as needed or to upgrade specific equipment for improved energy efficiency. The interior plumbing material can be almost anything except cast iron pipe, including copper, plastic pvc, or galvanized steel. In Baltimore City the sanitary sewer and stormwater sewer are separate and the house sewer pipe is generally black steel or cast iron if it is older. At this time it is unknown what the city main supply pipes are made of. To our knowledge the row houses do not have foundation drains. Storm water spills from the downspout on the rear directly to the pavement and then flows to the grated access points in the alleys. Generally the plumbing system is completely replaced. Plumbing fixtures also vary and the piping is replaced with PVC pipe. PVC is used due to the problem of having copper piping stolen from the job sites during the renovation.

The electrical system may combine a variety of wiring types and ususally is a 100-amp service on a circuit breaker panel. For PP-CDC the electrical system is almost always replaced with a new wiring, outlets, switches and a new 100-amp service. The houses are *not* tightly constructed and the basements tend toward being damp but not wet. We were not able to get information on the existing house’s air infiltration rate but performing a “blower door test” after renovation is highly recommended for either the CDC or for the new Homeowner. Such a test will give the Owner a good indication of what they can expect regarding the energy performance of their homes and how much conditioned air they can expect to loose due to air escaping from cracks, voids etc.

The mechanical, plumbing and electrical systems for the houses are generally:

- Heating – oil or gas fired boilers or furnaces located in the basement, for a convection flow hot air system, through floor vents or heavy steel ducts
- 40 gallon domestic hot water heaters — gas
- Window air conditioning units (if any) – by owner, electric and older models which are less efficient
- No ceiling fans or other mechanical ventilation, only natural flow from windows, doors, and vented skylights if operable.
- Some homes had hot water radiator heat that has been removed.

1B Renovation Plans – PP-CDC Gut Rehab

The following plan is usually followed:

- PP-CDC, first meets with the prospective homeowner and makes a new plan floor plan, usually removing most interior of the walls for new layout.
- Demolition of all plaster work and interior partitions, remove "Permastone" facing or other facing on exterior
- Repair cracks in brick replace or repair rear porches
- Repair or replace structural elements, decking, damaged roof assemblies (generally do not replace roof unless damaged); replace gutters if needed
- Restore cornice if possible, re-point brick if needed
- New interior walls at End walls and Party walls, end walls get insulation
- Add drywall to party walls, direct application, (glue and mechanical fasteners)
- Replace all windows with vinyl replacement, insulated glass, double-hung windows, with screens
- New interior and exterior doors, repair stair if needed, refinish stair, balusters and handrails. If interior doors are in good shape, they are often re-installed in the home. Exterior doors are always new.
- Little work is done in the basement, no insulation or drywall added to basement or party walls
- All new central, forced air mechanical heating and cooling system
- New kitchen including floor (sheet vinyl with upgrade to ceramic tile avail), cabinets, counter tops, and appliances
- Do not increase the electric service size but do replace the system, add appropriate outlets, wiring etc, junction boxes in center of ceiling added for owner purchased ceiling fans, replace light fixtures
- Carpet upstairs, may refinish wood floor on first floor,
- Paint all interior and trim
- Refurbish bathroom and add half bath downstairs if Owner requests, replace plumbing fixtures if needed
- No work to the rear yard unless fence repair is needed.

For the more modest rehabilitation projects done by ME-CDC, the following plan is followed:

- ME-CDC generally rehabilitates units then leases or sells them after the rehab is completed;
- Test for lead paint and other sources of lead in all units – goal is to sell or lease each unit as "lead free". Currently units are considered "lead safe" through encapsulation or other techniques;
- Demolition where needed, patch and repair is done rather than replacement, leave existing interior walls as much as possible;
- Repair or replace structural elements, decking, damaged roof assemblies (generally do not replace roof unless damaged); replace gutters if needed;
- Replace some or all of the windows (8 max) with vinyl replacement, insulated glass, double-hung windows and screens;
- New interior and exterior doors, repair stair if needed;
- Little work is done in the basement, no insulation or drywall added to party walls;
- Evaluate existing mechanical and repair or replace components as necessary, only components which need to be replaced. are done;
- Upgrade Kitchen with new floor (vinyl sheet or tile), cabinets, counter tops and appliances

- Electrical systems are brought up to code
- New carpet in living room, dining room, upstairs replace or add carpet if needed, clean CT in bathroom
- Refurbish bathroom, new fixtures if necessary
- No work to the rear yard.

1C Existing Conditions – Component Table

ELEMENT	SIZE	% AREA
Area per floor	12.5' x 48' = 600 GSF	33% total area
Perimeter per floor	121 LF	
Front End Wall above grade	270 GSF	8.5% tot. wall area
Front End Wall BSMT(below gr)	70(Ea)	
Window/openings	65 SF	24% of front wall
Rear End Wall above grade	250 SF	8% of tot wall area
Rear End Wall BSMT(below gr)	70(Ea)	bsmt = 13% of tot wall
Window/openings	55 SF	22% of rear wall
Party Wall (2) above grade	1,000 (each) GSF	31% ea of tot wall
Party Wall (2) BSMT(below gr)	265 (Ea)	
Roof	600 SF	50% tot Building Envelope
Total Window Count	Average size = 12.5 SF, 30" x 60"	8, basement windows often glass blocked
Total Doors EXTERIOR	2, Solid Core wood, Sometimes with Storm Door	
Total Doors INTERIOR	8 to 12 depending on no. of closets	Wood, raised panel
MECHANICAL	**Size**	**Fuel Source/cost**
Furnace or boiler	Varies	Natural Gas, or Oil
Air Conditioning	Window Units	Not available
Domestic Hot Water	Varies	Natural Gas
Return air grilles	4 total (3 2cd fl, 1 1st)	
Thermostat	1	Central location, first floor usually near stair.
PLUMBING	**Size**	**Quantity**
Toilets	5 gal per flush?	2 (Usually 1 or 1 added to basement)
Sinks – Bathroom	7 gal per minute?	2 (Sometimes 1 small in Bathroom)
Tub/Shower	Cast Iron stand alone on claw feet, hand held shower or built in cast iron with shower head	1 (Perhaps 60 gallon capacity)
Sink - kitchen	Cast Iron, no disposal	1

SECTION 1: Existing Conditions Analysis

ELECTRICAL		Upgrade
Main Service	100 Amp, Circuit breaker panel Overhead power & telephone	100 amp service
Clothes dryer outlet	Usually none, hang clothes to dry	220v outlet
Smoke detectors	Wall mounted, battery operated if any	Hardwire
Junction boxes (wall & ceiling)		
NEW APPLIANCES* *For most rehabs all appliances are replaced the following list is for the recently completed PP-CDC project at 39 N. Linwood.	**DESCRIPTION**	**MODEL**
Refrigerator	18 CF top freezer	Frigidaire FRT18 IC 5AW
Stove/oven	4 burner gas w/oven	Frigidaire FGF 355CGS
Range Hood		Frigidaire HD 4130 W
Microwave	O.P.???	
Dishwasher		Frigidaire FRT18 IC 5AW
Clothes Washing Machine		Frigidaire FWS 235 RFS
Clothes dryer	Gas?	Frigidaire FDE 437 GHS
		NOTE: Total cost of appliance package=+/- $1,3000

1D Cost of Renovation

Patterson Park CDC estimates approximately $40 to $50 per square foot – an average of $55,000 to $70,000 for a total gut-rehab renovation. This is within the range of the actual cost of the renovation listed in this edition of the GBT. PP-CDC noted that in the past they have used carpenters in training from the "Living Classrooms" program. However, they are currently using regular contractors and carpenters for their renovations. PP-CDC handles their own design work, construction management and general contracting for the renovation and then works with a variety of suppliers, vendors and subcontractors to complete the job at the most cost effective rates. PP-CDC will bid out some subcontracts but most are negotiated from a pre-selected pool of Subcontractors. Selection is based on the price and availability of the sub-contractor.

Middle East CDC estimates the total cost of their rehabilitation to be approximately $29,500. No square foot costs were available. ME-CDC acquires a property and either hires or receives pro-bono services for designer, architect or contractor to prepare the permit set. A General Contractor is hired to do the project and take on all responsibility for the completion of the project. ME-CDC has strong connections with the Clearing House for a Healthy Neighborhood and the HEBAC neighborhood association and is in a position to receive grant money and low interest loans for health initiatives.

Tim Duke noted that for-profit Contractors doing gut-rehab construction are finding square foot costs in a similar range to PP-CDC's costs. However, the Contractor's Overhead and Profit is generally higher giving an average of $75 to $80 per square foot range. Again, *it should be noted* that due to the nature of renovation work it is extremely difficult to figure accurate costs on a per square foot basis. There are too many variables or undisclosed conditions that a contractor may be faced with. Cost information for the more modest rehabilitation work can only be based what is actually involved in the project, as the scope of work may vary substantially depending on the specific project.

1E Potential Problem Areas in Baltimore Rowhouse Renovations

One hundred years ago, house construction was simpler, smaller and used fewer materials, systems, and equipment. Houses were not constructed very tightly, and plenty of fresh air came to the occupants through gaps between materials. These houses kept the rain out and the heat in during the winter, and let in plenty of natural daylight. People lived with a much wider "comfort zone" than we have come to expect of new construction. Modern houses, even renovated ones, on the other hand, are much more complicated and tend to generate interactive problems that must be addressed systemically or holistically. Smart designers, engineers and contractors think of the house as a system. Air movement and pressure, moisture and the exchange of heat are dynamic and highly inter-related variables. As such, the design of the mechanical systems, building envelope and air supply must take into account the anticipated performance of those variables and respond accordingly.

The project team first analyzed the two base study case houses, one from each CDC, and determined the primary problems and then established a series of upgrade packages to "green" the house and improve energy efficiency. Both sample properties are about the same age (early 1900s to 1920's) and of the same construction type and materials. We found that houses of this age and construction type have three primary problems, which are:

- Unwanted air Infiltration
- Moisture build up
- Poor insulation

Because of their similarity, the solutions recommended apply to both of the houses and could apply to most types of Baltimore Rowhouses. Middle East CDC also expressed a concern for creating healthy homes due to the high incidence of allergy and pulmonary related illnesses in their neighborhood.

These houses in general, if not damaged by water or roof leaks or fire, present a good armature for renovation work that can add many years of useful life. The foundations appear sound and major cracking on the brick due to settlement or shear stresses was not observed in these neighborhoods. Baltimore brick Rowhouses, traditionally were not built tight thus allowing a "natural" source of fresh air. They do not have particularly good insulation either in the walls, roof or through the windows that were originally single pane glass (non-insulated) and wood frame sashes (often proved to be "drafty"). Heating systems relied on large quantities of heat generated through coal or oil burning furnaces and boilers. The heating system, when fuel prices were lower, compensated for under insulated, drafty homes by dumping lots of hot air or hot water into the house. Natural ventilation provided the cooling. At the present time, however, we have the capability to overcome these inherent problems while using less energy, better, more waterproof construction materials and healthier building technologies.

Section 2 Related Initiatives: Green Building and Affordable Housing

2A Greening Affordable Housing

Project	City of Portland, OR Office of Sustainable Development publication, "Greening Portland's Affordable Housing," published April 2001.
Contact	Rob Bennett, Manager
Organization	Portland Office of Sustainable Development 1120 S.W. Fifth Ave. #706 Portland, OR 97204 503-823-7082 bennett@ci.portland.or.us http://www.green-rated.org
Synopsis	Thoroughly addresses aspects such as site design, energy, water, materials, indoor environment, and operations / maintenance. Emphasis is on new construction.

Project	Philadelphia Cool Homes Program, begun early 2000
Contact	Liz Robinson, Executive Director or Neal Resnick, Project Manager
Organization	Energy Coordinating Agency (ECA) 1924 Arch St. Philadelphia, PA 19103 215-988-0929 x238
Synopsis	Goal of program is to reduce indoor temperatures to healthy and comfortable levels without increasing customer's energy bills. Target client is a low-income elderly single resident of an inner-city rowhouse. Program combines insulation, window repairs, white roof coatings, and energy-efficient whole-house fans in lieu of window air conditioners which clients cannot afford to run.
Cost	$12 to $15 per gallon of roof coating. Typical installed cost is less than $2000.
Product	The coating becomes a tough, plasticized membrane that can appreciably extend the life of a typical built-up roof, perhaps as much as ten years. White coating is re-applied every ten years.
Source	*Energy Design Update* magazine, Feb. 2001, pp.3-4

Project	"A Blueprint for Greening Affordable Housing"
Contact	
Organization	Global Green USA 227 Broadway, Suite 302 Santa Monica, CA 90401 310-394-7700 ggusa@globalgreen.org www.globalgreen.org
Synopsis	Uses twelve case studies from around the country to illustrate a wide variety of green building strategies. These include urban renovations, new construction, energy and materials efficiency, innovative financing, renewable energy, water conservation, preservation of natural and historic features, and educating contractors. Discussion includes techniques and benefits for achieving these goals.

Project	Emeryville ReSourceful Building, completed 1998 +/-
Contact	Larry Strain or Henry Siegel

Organization	Siegel & Strain Architects 1295 59th St. Emeryville, CA 94608 510-547-8092 www.siegelstrain.com
Synopsis	Demonstration house, new construction of a 3 BR, 2-1/2 bath, 1-car garage house of 1600 SF. Project goals included infill development, energy efficiency, ease of operation and maintenance, reduced resource consumption, creating a healthy indoor environment, and providing a model for environmentally sound, affordable housing. Funding from the local waste management authority and the county recycling board allowed detailed cost comparisons of alternate assemblies for optimum environmental and cost performance.
Cost	The selected green assemblies increased the estimated project cost by about 3%, although the lowest contract bid was within budget. Detailed comparisons of assembly options for exterior walls, interior walls, roof, and floors allowed them to analyze the cost impact of greener construction.
Source	Emeryville ReSourceful Building publication by architects; available for purchase. Excellent information, drawings, cost and life-cycle analysis.

Project	State of New Jersey Sustainable Development / Affordable Housing Pilot Program
Contact	Darren Port, Director
Organization	New Jersey Green Homes Office New Jersey Department of Community Affairs Division of Housing and Community Resources 101 South Broad Street, P.O. Box 806 Trenton, NJ 08625-0806 609-292-3931
Partners	Public Service Electric and Gas Company (PSE&G) (New Jersey's largest utility), New Jersey Housing and Mortgage Finance Agency, the New Jersey Department of Environmental Protection, the U.S. Environmental Protection Agency, the State Energy Office and the New Jersey Commerce and Economic Growth Commission.
Synopsis	The purpose of the program is to determine how to incorporate sustainable design principles and energy efficiency into affordable housing. Sustainable development criteria include sound land use planning; minimizing impact on the environment; conserving natural resources; superior building design to enhance the health, safety and well-being of the residents; durable, low-maintenance dwellings; and making optimum use of existing infrastructure.
Pilot Project	The immediate aim of the pilot project is to solicit creative strategies to produce housing units for low and moderate income households that are affordable, can be produced with the application of reasonable public subsidy and meet certain sustainable standards. The longer-range purpose is to identify approaches to sustainable design that are reliable and can be widely replicated by affordable housing developers.
Funding Sources / Technical Support	*State-financed Balanced Housing Program will furnish subsidy up to $11 million.
Funding Sources cont'd	*PSE&G Energy Efficient Home (EEH) *5 Star* Program will provide builders with financial incentives to offset typical incremental costs of energy efficiency upgrades. Amounts range from $1200 to $2500 per unit. *Up to $5 million in low-interest single family mortgages has been committed by the New Jersey Housing and Mortgage Finance Agency *$200,000 has been committed by the State Energy Office to design and

	incorporate passive or active solar technologies *Technical assistance and logistical support from: Vermont Energy Investment Corporation of Burlington, Vermont, consultants to PSE&G; Steven Winter Associates of Norwalk, Connecticut under the Partnership for Advancing Technology in Housing (PATH) a program administered by HUD; and the New Jersey Sustainable Business Office
Source	Website: http://www.state.nj.us/dca/dhcr/sdhome.htm

Project	"I Have a Dream" Highly Efficient House in Atlanta, 2001
Contact	Chris Kielich, 202/586-5806 at DOE (press contact) Dennis Creech, Southface Energy Institute, 404-872-3549 x 110
Organization	Historic District Development Corporation
Synopsis	The 1,565 square foot home is certified under the Energy Star homes program. It demonstrates the affordability of high-performance and environmentally sound building products. The design is based on the "whole-house" systems engineering approach, which considers a house as a complete system instead of separate components.
Features	The walls, roof and floor are structural insulated panels (SIPs), factory-built energy-efficient walls with foam insulation. This technology allowed the builders to downsize the heating and cooling equipment and save on materials costs. The home also features Energy Star qualified windows, tightly sealed duct work, and a high-efficiency air conditioner that further enhances energy savings.
Energy costs	The department's tests show that the house will use 57 percent less energy for heating and cooling than a comparable house in the Atlanta area. Projected costs about $300 a year to heat and cool.
Partners	Georgia-Pacific Corporation and the Structural Insulated Panel Association – sponsors of the "Behind the Walls" demonstration house at the International Builders' Show in Atlanta, Georgia, summer 2001. Assisted by DOE's Building America Program and EarthCraft House, a green building program of the Greater Atlanta Home Builders Association and Southface Energy Institute. Bank of America was partner in the final version.
Source	Press release at DOE's website: http://www.energy.gov/HQPress/releases01/julpr/pr01125.htm

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Project	Churchill Homes, Holyoke, MA
Contact	William Zoeller 203-852-0110
Organization	Steven Winter Associates (design firm)
Synopsis	With financial assistance from HUD, the Holyoke Housing Authority is developing a mixed-income community of 272 affordable, energy- and resource-efficient townhouses and flats. It is being produced under HUD's HOPE VI program. Approximately 2/3 of the units will be owner occupied, with the remainder as rental. 5- phase one units are complete and occupied in September 2001.
Features	2 x 6 @ 24" on-center advanced framing for exterior walls, high efficiency unitized boiler / water heater combination, and controlled ventilation for indoor air quality. Units are designed to meet ENERGY STAR levels of performance.
Partners	HUD HOPE VI program

Project	Affordable Sustainable Technical Assistance for HUD HOME Program
Contact	Jim Maunder 866-367-6228 jimm@ncat.org
Organization	National Center for Appropriate Technology (NCAT)
Synopsis	NCAT provides technical assistance for Community Housing Development Organizations and builders participating in HUD HOME programs. The web site www.homeasta.org was launched March, 2001.
Features	Assistance to recipients of HOME grants in incorporating sustainable design into affordable housing. The website provides step-by-step recommendations on how to make single family home construction projects more sustainable in the areas of resource, energy use, and occupant health. The site offers an encompassing overview of the principles of sustainable design, to introduce their application in affordable housing. Links to further sources of detailed information help to illustrate how actual projects are realizing the tremendous potential for creating affordable, sustainable homes.
Partners	HUD HOME Progam

2B Green Builder Programs in the U.S.

Built Green Colorado
c/o HBA of Metropolitan Denver
Kim Calomino, Administrator
1400 S. Emerson St.
Denver, CO 80210,
(303) 778-1400, Fax (303) 733-9440
http://www.hbadenver.com E-mail kcalomino@hbadenver.com
Created in 1995, program certifies green production housing. Includes a checklist from which builders may choose items from categories such as energy efficiency, land use, waste management, materials, and water. Features a yearly design awards program, as well as other events. Website has a listing of available materials, frequently asked questions, and participating builders.

City of Boulder Green Builder Program
Mike Weil, Assistant Director
Office of Environmental Affairs,
P.O.Box 791, 1300 Canyon Blvd., Boulder, CO 80306,
(303) 441-4191, Fax (303) 441-3090 fax,
http://www.ci.boulder.co.us/environmentalaffairs/residential/gp_overview.html
(requires rating of every residential home built or major remodel project)

Maryland-National Capital Building Industry Association (MNCBIA)
Susan Charleston / David Bergman, Program Coordinators
1738 Elton Rd., Suite 200
Silver Spring, MD 20903,
(301) 445-5400, Fax (301) 445-5499
http://www.smbia.org
(new residential homes)

Clark County Home Builders Association
Karen Snekvik, Executive Director
5007 NE St. Johns Rd.

Vancouver, WA 98661,
(360) 694-0933, Fax (360) 694-1606
http://www.cchba.com/green.asp
(new residential homes)

Build a Better Kitsap
Art Castle, Executive Director
HBA of Kitsap County, WA
5251 Auto Center Way
Bremerton, WA 98312-3319,
(360) 479-5778, Fax (360) 479-0313
http://www.kitsaphba.com
(new residential homes)

HBA of Central New Mexico
Anna Mayberry, Program Coordinator,
5931 Office Blvd. N.E. #2
Albuquerque, NM 87109
(505) 344-3294, Fax (505) 345-3795
http://www.hbacnm.com/MIS_BETA/green_builder/green.html
(new residential homes)

City of Scottsdale, Community Development
Anthony Floyd, Director
7447 E. Indian School Rd, Suite 300
Scottsdale, AZ 85251
(602) 941-6992, Fax (602) 994-2672
http://www.ci.scottsdale.az.us/greenbuilding E-mail afloyd@ci.scottsdale.az.us
(new residential homes)

Greater Atlanta Home Builders Association
"Earth Craft House" program
Phillip Ford, Government Affairs Director,
P.O.Box 450749, Atlanta, GA 31145
770-938-9900 x20
http://www.atlantahomebuilders.com E-mail pford@vivid.net,
(new residential homes)

Green Building Alliance
Rebecca Flora, Executive Director,
64 S. 14th St.
Pittsburgh, PA 15203,
(412) 431-0709
http://www.gbapgh.org
(green building education, working on City convention center addition, airport remodeling)

County of Santa Barbara
Brian Bosse, Planner -- Energy Division
1226 Anacapa St., 2nd floor
Santa Barbara, CA 93101-2010
(802) 568-2049 Fax (802) 568-2522 E-mail bbosse@co.santa-barbara.ca.us
(commercial and residential, fast track City energy approvals and reduced fees, marketing logo, and awards, plans are checked by volunteer group of professionals)

Wisconsin's Environmental Initiative
Green Built Home
16 N. Carroll St. Ste. 840
Madison, WI 53703
(608) 280-0360
http://www.wi-ei.org/GBH/index.htm

Municipal Programs

Frisco Green Building Program
Jeff Witt, Senior Planner
City of Frisco
6891 Main Street
Frisco, TX 75034
(972) 335-5540 x. 145
www.ci.frisco.tx.us/planning/greenbuilding_index.htm
As of May, 2001, one of the country's first cities with a mandatory green building program, and the first to mandate Energy Star standards. Addresses four main areas: energy efficiency, water conservation, indoor air quality, and waste recycling. Homes must attain a HERS rating of 86. Initial analysis shows cost premium for the energy upgrades will be $1,500 to $3,000. The cost of the HERS rating is about $750 per home. Partners include TXU Electric (local utility), which was independently supporting nearby Fort Worth Energy Star New Home Program. Subsidizes HERS inspections and Energy Star certification. Also provides services including plan analysis, training for trade contractors, job superintendents, and realtors. (source: Article in *Environmental Building News*, June 2001, pp. 4 – 5)

City of Los Angeles
Bill Holland, City Architect
Architectural Division, Bureau of Engineering, Dept. of Public Works
600 South Spring St., Suite 200
Los Angeles, CA 90014
(213) 847-6370, Fax (213) 847-5300 E-mail wholland@eng.ci.la.ca.us
(sustainable building guideline reference manual for city government building, emphasis on recycling, demolition and recycled products)

City of New York
Hillary Brown, Assistant Commissioner
Structures Div., Office of Sustainable Design & Construction
30-30 Thompson Avenue
Long Island City, NY 11101
(718) 391-1371, Fax (718) 391-1477 E-mail ddc1@rapidramp.net
(sustainable guidelines for City government buildings)

Hennepin County Dept of Public Works
Daniel Dixon
A 2208 Hennepin County Government Center
300 S. 6th St.
Minneapolis, MN 55487-0228
(program for county buildings)

City and County of San Francisco
Francesca Vitor, Department of the Environment Director
1540 Market Street, Suite 160

San Francisco, CA 94102
(415) 554-6397, Fax (415) 554-6393
www.ci.sf.ca.us/environment
(Resource Efficient Building Ordinance for City-owned projects adopted in 1999)

City of San Diego
Adam Saling, Sustainable Building Coordinator
Environmental Services Dept.
9601 Ridgehaven Court
San Diego, CA 92123-1636
619-492-5018, 5021 fax, B7S@sdcity.sannet.gov
(demonstration office building comparison, implemented a program for their own buildings, researching a "public" green building program)

Alameda County
Lee Spuhler
General Services Administration
1401 Lakeside Dr., Suite 1106
Oakland, CA 94612-4305
(510) 208-9642
lspuhler@gsa.mail.co.alameda.ca.us
(C&D waste recycling, now working on sustainable practice ordinances for county buildings)

Seattle Public Utilities
Lucia Athens, Resource Conservation Section
Community Services Division
710 Second Ave., Room 505
Seattle, WA 98104
206/684.4643, E-mail Lucia.Athens@ci.seattle.wa.us
http://www.ci.seattle.wa.us/util/RESCONS/susbuild/default.htm

Green Building Programs Under Development

City of Tucson, Sustainable Communities Program
John Laswick, Manager
Sustainable Communities Program
481 W. Paseo Redondo,
P.O.Box 27210
Tucson, AZ 85726
520-791-4675, 520-791-5431 fax, E-mail jlaswic1@ci.tucson.az.us
(sustainable communities program, researching a green building program, use green building elements in their community program)

City of Santa Monica
Susan Munves, Conservation Coordinator
Environmental Programs Division
200 Santa Monica Pier, Suite C, Santa Monica, CA 90401
310-458-8229, Fax 310-260-1574 fax, E-mail susan-munves@ci.santa-monica.ca.us
(developing commercial requirements for all new construction or major renovation within city)

City of Seattle, Sustainable Building Project
Peter Hurley, Sustainable Building Project Manager
700 Fifth Avenue Suite 3300

Seattle, WA 98104-5031
206-684-3782, Fax 206-684-3385
http://www.ci.seattle.wa.us E-mail peter.hurley@ci.seattle.wa.us

King County WA -- "Encompass"
Ann Thorpe, Program Analyst
201 S. Jackson Street, Suite 702
Seattle, WA 98104
206-296-3740, Fax: 206-296-4366
http://www.metrokc/market/encompass E-mail ann.thorpe@metrokc.gov,

Pennsylvania Department of the Environment
James Toothaker, Bureau Office Systems and Services
400 Market Street PO Box 8473
Harrisburg, PA 17105
717-787-4190, Fax: 717-772-3278
http://www.dep.state.pa.us E-mail toothaker.james@dep.state.pa.us

HBA of Colorado
Doug Seiter, (303) 421-4889,
E-mail greenhome@aol.com

City of Chula Vista
Barbara Bamberger
276 4th Avenue
Chula Vista, CA 9190
(619) 691-5296, Fax (619) 585-5612 fax,
E-mail Bjobam@aol.com
(EPA grant to develop green building program)
City of St. Paul
Chuck Ekstedt
140 City Hall
15 W. Kellogg
St. Paul, MN 55102
(starting program for renovation and new municipal facilities)

GreenHOME
PO Box 30884
Washington, DC 20030-0884,
(202) 24 GREEN fax (202) 562-4336
(a 501(c)(3) non-profit organization consisting of all volunteers from throughout the Washington, DC area, they conduct educational efforts and have built a demonstration home in partnership with the local Habitat for Humanity chapter)

2C Response to Morgan State University Report

The Project Team reviewed the Morgan State University Report and found it to be helpful and a good starting point. Our energy analysis concurred and supported the findings of this report. This report gave very good information concerning energy but did not take an integrated approach. Therefore, other problems associated with affordable housing renovation such as moisture, air infiltration and healthy indoor environment were not addressed simultaneously, giving a solution to only one piece of the puzzle.

However, the MSU Report demonstrated an effective approach for the study by utilizing students to conduct eh study and then partnering with the prestigious Oakridge National Laboratory to assist with the analysis and software tools. This may be an advisable strategy for DNR to pursue as they work toward expanding the scope and analysis of the Green Building Template. In addition, it is a good way to train the next generation in sustainable design and construction by starting at the University or College level.

Section 3 Green Template Overview

There are five overall goals for Green Template in the following order of priority

1. First, to increase energy efficiency and comfort.
2. Second, to create a healthy indoor environment.
3. Third, to reduce resource consumption by specifying earth-friendly materials and water-saving fixtures, and instituting a program to recycle demolition and construction waste.
4. Fourth, the houses should be easy to operate and maintain.
5. Lastly, the houses should contribute in a positive way back to the community.

This version of the Green Template looked in most detail at the first three goals. This report includes a detailed discussion of these three, as well as an overview of the fourth and fifth goals.

3A Energy Efficiency And Comfort

3A.1 Introduction

One of the most important and cost effective measures toward sustainable renovation is to increase the energy efficiency and comfort of the homes. The team approached the energy efficiency assessment of the Baltimore row house in a three-fold manner. First we examined actual construction of row houses, reviewed a previous energy study in the Baltimore area, and reviewed potential areas for energy improvement. Then we conducted over 70 individual computer analysis runs to develop the energy recommendations in this report. Finally, the Project Team developed three implementation packages which contained upgrade measures capable of producing three levels of performance -- good, better, best or light green, medium green, and deep green.

These proposed packages were subjected to Energy-efficiency rating procedures using National Uniform Standards, approved in late1999, by the Residential Energy Services Network (RESNET) and their allies in the Mortgage banking industry for over 30 states. While not yet adopted in Maryland, the Maryland Energy Administration (MEA) currently has a new program authorized to develop an Energy Efficiency Lending and HERS - Home Energy Rating System -- to support it, statewide for new and existing housing. The measure packages selected in the analysis process were directly implemented into the Green Building Template worksheet -- known as "the Matrix" in this report.

The energy analysis demonstrated that a combination of integrated strategies will save energy with the most cost effective strategies proving to be:

- ✓ **Improve the building envelope** by adding insulation to exterior walls and roof assemblies, better weatherization practices, installing quality, insulated, low-e windows
- ✓ **Install higher efficiency equipment** for heating, cooling and hot water heating, seal ducts with mastic
- ✓ **Control the amounts of moisture** within the house generated by unconditioned outside air infiltration or by moisture producing activities inside the house

The energy analysis showed that by implementing different levels of the above stated strategies, called “lite green”, “medium green” and “deep green” as shown on the Matrix, that potential savings of 20%, 40% and 72% could be achieved over the base case analysis. Although these savings translate into reduced annual energy costs, the savings are not quite as dramatic as would be found in a stand-alone single family dwelling implementing the same strategies. From an energy conservation perspective, mid-block Rowhouses are fairly efficient as there is much less exterior wall and roof surface, heating gains can be achieved through the “stack effect” of the narrow footprint and there are fewer window or door openings. Additional benefits to incorporating energy conservation measures include lowering green house gas emissions and reducing reliance on fossil fuels.

How much energy does the average American household consume ? – The average American house is approximately 2,200 gross square feet, with an annual energy cost between $1200 and $2400 on heating, cooling, electricity and water/sewer use each year. (Real costs of a sample rowhouse annual energy cost was around $990 for heating and cooling and $ 120 for water bills.

HOW ENERGY IS USED IN A HOME
According to BG&E data a household energy budget goes to the following:

Heating and Cooling 44%

Water Heating 14%

Refrigeration 9%

Lighting, Cooking, Appliances 33%

(From BGE website, Oct 2001)

POWER – ELECTRICITY - Residential energy consumption is significant. We use approximately 10,000 kWh of energy per household per year.

FUEL – Natural Gas --The average home uses 175 therms of energy per year or 17.5 million btus

The average car, driven 15,000 miles per year getting an average of 22 miles per gallon ends up consuming about 852 therms of energy per year. One gallon of gas = approximately 1.25 therms.

WATER CONSERVATION -- This will be discussed in more detail in Section 3C but after fuel, the next biggest resourced used in single-family households is that of clean, potable water. The average household in the Chesapeake Bay watershed uses between 75 and 100 gallons of water per day per person (US Census 2000). We only need about 4 gallons a day to survive and perhaps about 30 gallons to match our current style of living. The total water consumption for 34 N. Linwood for the year 2001 was considerably less than the national average at approximately 15,700 gallons per year.

3A.2 What Measures Really Boost Energy Efficiency?

Installing energy efficient features can produce a good rate of cash flow and returns on your investment if done in an integrated manner. As noted above, the GBT recommends some basic strategies that are further elaborated in this section.

Retrofitting an existing building can create an energy efficient home. There are several key features to look for in a truly energy efficient home. The considerations outlined below have been shown by building science studies to work together as a whole-building package to provide excellent performance. Just picking one or two categories will not necessarily provide a comprehensive energy efficiency and indoor air quality "package." Energy efficiency should also be implemented in a way that does not compromise good indoor air quality should include the systematic consideration of the following key areas:

Building Envelope:

- The building "shell" or ”thermal envelope” needs to be protected from excessive heat loss and gain. US DOE and trade and consumer organizations have published "R-value" recommendations for insulation levels appropriate for the climate zone.

- Weatherization is the practice of good air-sealing employed to reduce air infiltration -- this should include accurate caulking and weather-stripping using a "blower door" test as part of an energy audit on an existing home as well as new construction (ask your builder to provide this service).

- Efficient windows and insulated doors including "Low-E" or "Heat-Mirror" glazing, and sliding glass doors with thermal pane glazing, should be used, and double-glazing should be considered in all air-conditioning climates.

- Passive solar "climate specific" design, specifically tuned to the local climate, helps to further reduce heating and cooling loads -- can be very beneficial in most climates.

- Research shows proper selection of landscapes and exterior surface color produces benefits for reducing cooling. Using lighter color home exteriors (particularly roofs), and positioning of trees and shrubs to shade west-facing surfaces helps to reduce air-conditioning loads. Appropriate landscaping increases evaporation and transpiration from plants that helps provide "evaporative-cooling" around homes.

High Efficiency Equipment:

- Install high-efficiency HVAC System mechanical equipment (furnaces, boilers, heat-pumps and air-conditioners) at least meeting the National Appliance Energy Conservation Act (NAECA) levels, or EPA Energy Star Appliance ratings.

- It is vital to seal and insulate the HVAC ducts and return-air paths to indoor spaces to avoid excess heat loss, leakage of heated and cooled air and irritating dust or insulation particles entering the space; hydronic piping systems should be insulated.

- Distribution systems will be more efficient if located inside the heated/cooled spaces; it is best to avoid ducts in floor-slabs and in crawl spaces where radon gas or mold spores could be circulated.

- Hot water system can generate 15- to17% of the utility bill in an otherwise efficient home. Spigot temperatures should be set to about 120 degrees (tank may need to be at 140 F to achieve this); storage tanks must be insulated, cycle timers installed, and hot-water piping should be insulated.

- When water heater replacements are planned, consider solar water heating and "tank-less" water heaters.

- Lighting and major appliances are major electricity users, and should be chosen with efficiency in mind. Modern compact fluorescent bulbs and fixtures should be used, and the most efficient replacement appliances -- particularly refrigerators -- should be purchased.

Controlling Moisture:

- An occupant-controllable mechanical ventilation system (an upgrade from typical bath or kitchen fans) can be installed providing reliable flow of fresh air helping lower indoor pollution levels. In most temperate climates just relying on leaks in the building, small fans or opening windows does not lead to good ventilation.

  Recommended whole house Air Changes per Hour (ACH) via mechanical ventilation: 1/3 to ½ ACH is a good operating range for such systems.

- Weatherization strategies help with controlling moisture diffusion through exterior wall and roof assemblies by caulking well and thoroughly around windows and other penetrations to limit to moisture vapor entry via convection (air leaks).

- In this climate, recommend a moisture vapor diffusion retarder on the *warm* side of the wall and insulation, such as a coating of vapor retarding paint.

3A.3 Avoiding "bells and whistles" or measures that do not work

Remember the old "saw" -- if it sounds too good to be true it probably is. Today's energy efficiency market is loaded with good ideas and fine technologies. The best approach is to obtain a whole-house energy audit or energy rating first, as recommended earlier. This way you get a clear picture of overall energy "fitness" of a home, without being distracted by individual product claims. For example, in some climates a radiant barrier attic system might be totally useless, diverting money from more serious deficiencies.

Another example is: a solar water heater might make more sense where electric rates are high, in a home with adequate building insulation and a reasonably efficient HVAC system. That is because hot water is a large portion of the remaining load, and the fuel serving it is relatively expensive electricity. The energy audit or rating is really the only way to systematically sort out the options.

Another useful indication is the length and terms of any warranty or guarantee provided by the vendor or manufacturer. For more complicated energy products like a new furnace, heat-pump or air-conditioner, or for efficient appliances like a new refrigerator or solar water-heater, the warrantee should be specific on its coverage of defects in parts and labor. Warranties of 3 to 5 years, with specific coverage of major components are desirable. The product or system should clearly show evidence of complying with relevant industry standards and/or governmental certification programs. In the absence of a lengthy warrantee, some vendors may be willing to post a "performance bond," indicating they will pay the difference between the claimed savings and any real shortfall. Any such funds should be held in escrow, and contract clauses developed to describe the arbitration process to be used.

In this climate zone the cost/benefit analysis for installing a radiant barrier in the attic space is not recommended. Radiant barriers seem more suited to hotter climates with heavy air conditioning (cooling) loads.

3A.4 Thermal comfort

Humans have relatively few natural controls with which to adapt to changes in weather, or rapidly fluctuating indoor conditions. We use energy via our bodies' metabolism, seeking to maintain a core temperature close to 98.6°F.

At a given level of dress, the temperature, humidity, air-flows, proximity to windows (*heat gain or loss*), and to surfaces with heat-capacity (*brick or masonry mass*) all combine to influence one's feeling of comfort under real-world conditions.

The human body has three mechanisms to maintain this narrow temperature range. These include: 1.) metabolic heat generated inside the body; 2.) gaining heat from surroundings (absorbing heat), and 3.) losing heat to the body's surroundings. The body automatically makes constant changes to control these three mechanisms and regulate body temperature.

Factors Affecting Human Comfort

< Air temperature is the most significant ambient factor that affects our internal temperature and our level of comfort. Also, air speed (convection), humidity (moisture levels near the body) and mean radiant temperature must also be considered. Each of these four factors has a direct influence on the rate at which the body loses or gains heat to or from the surroundings. *Air Temperature* - This affects temperature difference between the body and the surroundings, consequently affecting the rate of heat loss or gain by convection.

< *Air Speed* - This affects the rate at which the body loses heat by convection. The chill factor is one way to quantify the effects of air speed on heat loss. Air speed is also very important during summer when the body is trying to lose heat to maintain comfort. This is why ceiling fans that move air past our bodies can be effective in reducing A/C usage.

< *Mean Radiant Temperature* (MRT) - MRT is a calculated comfort factor where the average of the surface temperature of the surroundings with which the body can exchange heat by radiant transfer. Radiant heat transfer to and from the body is quite apparent when sitting near a fireplace (high MRT) or large cold window area (low MRT).

< *Humidity* - Affects the rate at which the body loses heat by evaporation. During hot weather, high humidity increases discomfort by making it more difficult to evaporate perspiration into the air.

Human Responses to Discomfort -- The following are some ways the body responds in order to stay within the comfort zone:

- ✓ *Circulatory* (change in blood flow) -- Reduced flow to the hands, feet and skin surface when cold, to reduce heat loss to surroundings; an increase in blood flow to these areas when hot to encourage heat loss. When overheated the opposite effect is seen in "flushing" and sometimes-excessive circulation, where blood flow to the brain may be deprived (heat stroke).

- ✓ *Activity* (i.e. shivering, cold) -- Increased muscle activity and a higher metabolic rate increases internal heat production. Conversely, when overheated, the body needs to rest and humans tend to seek out shade, and ventilating breezes to cool off.

- ✓ "*Goose Bumps*" (follicular reaction - Cold) - Body hair is fluffed up to provide better insulation to prevent heat loss.

- ✓ *Perspiration* (sweating - Hot) -- Moisture moves to the skin surface to be evaporated to lower body temperature.

Maximizing comfort and minimizing energy consumption -- In an energy-efficient building, several things can be done to minimize energy use without sacrificing the quality of indoor comfort. Generally people can tolerate slightly warmer temperatures in the cooling cycle if the air is dry and slightly cooler temperature in the heating cycle if the air has the right level of humidity. Hence, a building's design and construction with the following attributes will more readily achieve comfortable conditions at reduced operating costs:

- resistance to excess moisture entry;
- an HVAC system that effectively controls indoor humidity levels (*recommended RH range: ~ 30% to 60%, by EEBA*);
- capability to circulate the indoor air; and
- by proper design and effective maintenance the indoor air contains fewer pollutant substances;.

Achieving energy efficiency and good indoor environmental quality, while maintaining comfortable conditions, is a constant process of tradeoffs and implementation of a holistic design strategy.

3A.5 GBT Recommendations for Insulation in Baltimore Rowhouses

One of the most cost effective strategies for achieving good thermal comfort is to add insulation to exterior walls and roof/ceiling assemblies. Substantial heat transfer can occur through the walls, roof assembly and windows or doors without insulation of some kind. Heat transfer is another dynamic condition, which changes constantly as heated air seeks equilibrium with the temperature of adjacent air or material. Thermal insulation is the most cost effective means to minimize and direct the transfer of hot or cold air. The thermal envelope should be continuous, consistent and appropriately sized for the local climate, by using the right thickness of insulation materials, thus minimizing the transfer of conditioned air (paid for by the Owner) to unconditioned spaces.

The U-value or R-value is the measurement of the ability of materials and construction assemblies to transfer or retain heat. The R-value is a calculated measurement of the *resistance* to heat transfer by conduction. While the U-value represents the inverse, or the measurement of how quickly heat is conducted through a material. The R-value is the more common reference and is often found on insulation labels, windows, glass or doors. A higher R-value means better insulating properties than a lower value.

Another factor to consider in designing an effective thermal envelope is the concept of "thermal bridging" which also involves the physics of heat transfer. One material will transfer heat at a different rate than an adjacent material, potentially creating pockets where condition air can escape from where it is needed. Therefore insulation materials should have minimal gaps, be sealed at joints, or completely fill voids in cavities. Materials that have radically different heat transfer properties should not be placed side by side or should allow for a thermal break in the material. For example, this is often needed in aluminum frame windows in northern climates, where cold air moving from the outside to the inside of the frame can often cause condensation or frost build-up. If the frame has an internal "break" of non-conductive material, then the heat is not transferred as easily.

For our case study houses, there is no insulation in the exterior walls of the houses which are made up of 8" to 12" of brick or other masonry material. Minimal or deteriorated insulation can be found in the attic spaces and no insulation is found either in the basement ceiling joists, or on the exterior basement wall surfaces.

WINDOW SELECTION

Windows are now rated by the NFRC for energy efficiency. Glazing type and number of sheets of glass, frame type and material, and films or gas fillings impact the energy efficiency of windows. The NFRC gives a R-value for the center of the glass for an average rating of the whole assembly.

A traditional double pane wood frame, double hung window has an average r-2 value. New windows can range up to R-4 or R-5 depending on type and construction. The higher R value the better the energy performance of the window.

Energy Efficient windows can save up to 6% on a home's heating bills.

Low-e film or coatings are recommended in colder climates

The thermal properties of brick are such that it is good for thermal storage and slow to transfer heat, but it is a surprisingly poor insulator. The average 12" thick masonry wall has an R-2 to R-4 rating whereas a standard 2 x 4 wood stud wall with insulation and a brick veneer will perform at an R-13 value! Most of the case studies do construct a new interior wall with added insulation on the exterior walls.

By improving the insulation values of the building envelope, a homeowner also can take advantage of any passive solar energy the house may achieve due to orientation. For example, installing low-e coated windows will trap solar radiated energy inside the home during the winter and the improved insulation will help it stay in the house.

Or, if large areas of glass face west and can hit a ceramic tile or other thermal mass type wall, this will also offset energy loads for heating as long as the windows are properly screened during the summer months.

Goals: Improve the insulating properties of the building envelope
Install insulation as compactly as possible and limit gaps, breaks changes in material or density

Recommended Solutions:

1. Add insulation to achieve the following levels:
    - Front and Rear Exterior Walls = R-13 to R-19; may have to build out walls with stud for installing insulation or use rigid insulation on metal studs or channels.
    - Party walls do not need to be insulated except for sound if preferred by the Owner
    - Roof = R-30, prefer R-38
    - Basement = Exterior walls above grade to receive min R-13 drape.
2. Wall Insulation -- Install insulation in wall cavities that will fill voids such as wet blown cellulose, or "air-krete" solid cementitious foam. If batt insulation is used, install kraft-faced batt and tape joints or seal edges to studs (also enhances air barrier properties of the wall). There is no need to use "foil faced" wall insulation in this climate for the first and second floor exterior walls.
3. Drape R-11 with foil face on above ground portion of basement walls
4. Install minimum R-4, insulated windows with low-e coating
5. Install min R-4 exterior doors or provide storm doors for all exterior doors
6. Aluminum window frames, if used to be "thermally broken"
7. If installing new basement slab, may want to consider 1 ½" rigid insulation for 24" length at the perimeter to create a thermal and bond break between basement walls and the new concrete slab
8. Wrap hot water pipes with pipewrap insulation for at least 8' of length from water source and hot water heater. If hot water heater runs are over 20' then entire hw run should be wrapped also.
9. Vent the attic so that the insulation stays dry and performs correctly or create an airtight, unventilated attic space.

3A.6 GBT Recommendations for Minimizing Air Infiltration in Baltimore Rowhouses and Proper Ventilation

Part of the energy and comfort story in Rowhouses includes limiting the amount of air infiltration through the home and yet maintaining appropriate levels of fresh air through natural or mechanical ventilation. Due to the urban conditions of the Baltimore rowhouse, it may be difficult to achieve adequate natural ventilation that is clean and at the correct temperature and humidity levels. Minimizing natural air infiltration also helps in vapor transfer which is probably a more serious potential problem for these houses.

High Levels of Outside Air Infiltration

A surprising amount of either conditioned or unconditioned air is constantly moving through houses in one direction or the other depending on the temperature and pressure differential between the outside and inside of the house. Baltimore Rowhouse homeowners know that un-renovated houses can often be drafty or leaky, have loose fitting windows and doors, and significant gaps in the attic area. If the air is already conditioned and "leaks" out of the house, the homeowner has paid money to heat or cool air that is simply lost. If unconditioned air enters or "infiltrates" into the house, it often has higher moisture content and the Owner must "pay" for the energy required to heat, cool or dehumidify that air.

An owner can significantly reduce energy costs and moisture penetration by controlling the amount air infiltration through:

- ✓ Careful caulking
- ✓ House wrap or installing air barriers
- ✓ Better window frames, which are properly caulked on the inside and outside
- ✓ Sealing holes and pipe penetrations
- ✓ Sealing ductwork with a mastic compound (for a forced air system)

Although controlling unwanted or unconditioned air infiltration is important, we also do not want to make the house too "tight" and not have enough fresh air for the occupants. The source of that air can be natural ventilation, mechanical ventilation or fans, or by openings in the building envelope such as doors, windows or louvered vents. Fresh air is in short supply when the house feels stuffy and filled with "flat" or stale air, becomes depressurized so that fresh air is drawn out of the house, or experiences high levels of indoor pollution from sources such as cooking or smoking. In addition, appliances and heating systems that burn fuel, such as a gas stove, require a fresh air intake to burn and produce energy for heating or cooking. Houses constructed too tightly, that do not breathe, can even become dangerous if levels of carbon monoxide or natural gas should build up inside the home, or can be a more severe health hazard to occupants with sensitivities to allergies or to chemicals.

This supply of air is measured in ACH (air changes per hour) or by a quantity such as cubic feet of air per minute (cfm). The air changes or ventilation are needed to deliver fresh oxygen to living organisms, dilute indoor air pollutants, and to create make-up air for equipment. A blower door test measures the amount of air leaking out of a structure and is based on the pressure differential between the inside air and outside air. Measurements of Air Changes per Hour (ACH) are important in order to establish a baseline for the house before and after renovation. The ACH refers to the number of times the total volume of air in a house is replaced with outdoor air The tighter the house, the lower the ACH number will be. A very tight home may have a .25 ACH measured at 50 Pa (pascals - the pressure differential between inside and outside).

Controlling air infiltration and balancing fresh air levels can be a fairly complicated and dynamic problem, but a most important one in achieving healthy, energy efficient homes.

Goals: Control unwanted air infiltration
Balance supply of fresh air with conditioned air requirements

Recommended solutions:

1. Enhance air tightness of house by applying proper caulk to windows, doors, and penetrations
   1a Caulk around outlets, junction boxes, and panel boxes
   1b Seal all penetrations through ceiling and attic with non-cfc foam sealant.
   1c. Make sure that any significant gaps, cracks or holes in the masonry walls or plaster system are filled.
2. Test house with Blower Door for recommended ACH of ..25 (considered a very tight home and should have some kind of mechanical ventilation)
3. A well sealed and taped air barrier is recommended on the front and rear exterior walls. The air barrier is primarily needed to reduce the flow of moisture-laden air across the wall assembly. Ideally the air barrier should be installed on the inside face of the outside masonry wall. However, in Baltimore Rowhouses, this is difficult to achieve because of the large window openings and small frontage of the exterior walls. There are three potential options:
   3a. Construct a stud wall for insulation on the floor, apply "Tyvek" type air barrier to rear side of wall, tape and seal and lift into place. Then insulate and apply airtight drywall. This option is difficult due to the amount of shimming required or leveling required for the existing walls.
   3b. A preferred option may be too add wood lath strips to the rear face of the exterior walls, tack up the air barrier to the lath, which also needs to surround openings and then tape or seal all joints.
   3c. Use kraft faced batt insulation in new stud walls, fasten tabs to face of studs and tape all joints. This will provide a decent air barrier.
4. Provide positive, weather stripping for all doors and windows
5. Evaluate mechanical ventilation versus natural ventilation. At a minimum install at least 75 cfm exhaust fans in bathrooms, laundry rooms and in the kitchen vented directly to the exterior.

AIR LEAKAGE SOURCES

Much of a Homeowner's energy cost can be traced to air leakage or infiltration. The following BG&E chart shows where air leakages generally occur. Sealing up air leaks at their source means money in the pocket of the homeowner.

Ducts	15%
Plumbing penetrations	13%
Windows	10%
Doors	11%
Fans and vents	4%
Fireplace	14%
Sill, wall, and ceiling	31%
Electric outlets	2%

Source: U.S. Department of Energy.

3A.7 GBT Recommendations for Moisture Control in Baltimore Rowhouses

The next major problem area lies in controlling the amount of moisture within the house. Uncontrolled water, in its many forms, can be quite detrimental to houses and the homeowner's worst enemy. Water, generally in the form of vapor is in constant motion between interior and exterior, depending on the pressure differential. Water vapor is the element of most concern for creating a healthy house. As with air infiltration, and as houses are made "tighter" to improve energy performance, internal moisture control problems may develop.

Moisture in the air is commonly measured by taking the relative humidity as a percentage of total air saturation. Relative humidity in the 30% to 50% range is usually acceptable in winter, and 40%-60% is tolerable in the summer. The interaction of temperature and humidity levels can significantly affect people's sense of being "comfortable" in a space. Higher temperature air can be tolerated if the air is drier while cool air that is more humid often makes a space *feel* colder.

Moisture that tends to get trapped inside wall assemblies or in unventilated, moisture producing rooms such as bathrooms can cause mildew and mold to grow, compromise the energy performance of systems and eventually cause structural damage.

Water vapor that saturates the batt insulation eventually destroys the wood studs through rot, and can be a source of irreparable mold growth that creates serious health problems in turn. Also, tighter houses can hold internally generated moisture from cooking or bathing at higher levels unless that moisture is adequately vented to the exterior. According to the book Homemade Money, "A family of four will put nearly two gallons of water per day into a house."[1] In sophisticated systems, heat found in moist exhaust air can be recaptured through a heat exchanger device on the heating or ventilating systems.

The second area of concern regarding moisture penetration lies in keeping rainwater and other kinds of precipitation out of the house. For our case study houses, the brick veneer acts as a rain screen – keeping most of the liquid water out. It cannot, however, prevent the capillary action of water coming through the mortar or even the brick. Mortar, especially old mortar, is a porous material. Over time, moisture seeps through to the interior of the wall. If the wall is a cavity wall or vented, this moisture can escape through "weep" holes at the bottom of the wall. However, our walls do not drain, so interior wall assemblies with new insulation must be protected from this kind of moisture transfer.

Cracks in the mortar allow for a much more direct penetration of water. Older masonry construction can also trap water in a "freeze-thaw" cycle, be sealed improperly or covered over with a new surfacing material. If vapor cannot escape, it will rapidly deteriorate the actual masonry material. The masonry then starts to crumble and may even lose structural integrity. This trapped vapor can also damage new building materials installed over old masonry.

Finally, moisture in the form of dampness, usually from foundation wall contact with soil or rising damp, is a problem that can impact the indoor air quality and health of the occupants. The most likely source of dampness will be found in the basements from either rising ground damp or moisture transfer from ground soil to below grade basement walls. In the case study houses, the basements are generally not conditioned and therefore cannot dry out. Leaks from window wells, sewer backups or pipe bursts can cause basements to flood or hold quantities of water for long periods of time. Since basements tend to be darker, and slightly damp they tend to be good hosts for must, mold, fungi and other organisms that can cause significant allergic reactions and contribute to poor indoor air quality especially if air is distributed from the basement to other parts of the house. In addition, if there is a high ground water table or "clayey" subsoil, water might get trapped under the floor slab. In the case of dirt floors, additional moisture and dust can cause poor indoor air quality and add particulate pollution to the inside of the house.

MOISTURE CONTROL SOLUTIONS:

Goals: Prevent moisture from penetrating construction assemblies and causing damage in hidden places
Mechanically ventilate internal moisture directly to exterior

Recommendedations:

1. Recommend adding a low VOC, Vapor Retarding Paint on inside face of exterior walls and party wall face. The VR paint helps prevent moisture flow in situations where a full vapor barrier cannot be installed or where properly vented masonry cavity walls are not part of the construction.
2. Install properly sized ventilation fan in bathroom and kitchen, laundry areas of house (at least 75 cfm fan, inline fans are quieter, put automatic timers on fans)
3. Prevent air distribution from basement to rest of house
4. Carefully inspect roofs, walls, basement conditions, window wells, gutters and downspouts for leaks, holes or gaps. Leaks in the building envelope or constant wet conditions on the building envelope will create the most serious moisture hazard and can quickly deteriorate building assemblies, allow mold to grow and ruin the insulation value. Sidewalks and rear paving should slope away from the house, downspouts should drain to city sewers and not allow dripping on the wall surface.

[1] Homemade Money, p. 46

3A.6 References

_____. "Insulation -- Fact Sheet." DOE/CE-0180. U.S. Department of Energy, Consumer Affairs, 1000 Independence Ave. SW, Washington, DC 20585

_____. "What to Know About a Home Energy Audit." Consumer's Research. Jan. 1990.

Crenshaw, R. and R. E. Clark. "Optimal Weatherization of Low Income Housing in the U.S." 1982. U.S. Dept. of Commerce, NIST, Gaithersburg, MD 20234

Howard, B. D. and M. Hopkins. "Increasing Energy Savings in Weatherization Programs." March 1992. Alliance to Save Energy, 1725 K. St. NW #509, Washington, DC 20006.

For a more a more in depth analysis of energy use and recommendations for saving energy in single family rowhouse homes, please refer to Appendix B3 at the back of the GBT.

For more information on comfort please see Appendix B3.2, The Bio Climatic Chart.

3B Creating a Healthy Indoor Environment

After achieving affordable thermal comfort, the next most significant The Green Building Template also addresses issues of making the homes healthier to the occupants and to the environment. To that end we have included recommendations for environmentally friendlier building materials, ways to minimize indoor air pollution levels and ideas to enhance the safety and well being of the occupants. These recommendations are also inter-related to the energy saving and indoor air quality issues previously discussed, as these factors significantly affect the occupant's comfort and health. After thermal comfort, paying attention to indoor air quality and moisture control are the best strategies for creating a healthy indoor environment.

3B.1 Healthy Design Principles

The US Environmental Protection Agency estimates that we spend about 90% of our lives indoors, and that most buildings have fairly poor indoor air quality. Indoor air quality is a factor of quantities of fresh air, moisture control, indoor pollutants and moisture control. These problems represent significant health cost's to communities; often borne by public assistance programs; can create lower workplace productivity; and have been documented to reduce child academic performance, according to studies.

The Minnesota Sustainable Design Guide lists basic considerations for healthy and comfortable indoor condition conditions, which is captured in the following general outline (expanded by authors). (A link to the Guide is included in the Resources section of Appendix B)

Indoor Air Quality --

1. Ample ventilation for pollutant control while not compromising thermal comfort --via appropriate quantities of fresh air circulating through the house.
2. Moisture control to prevent microbial contamination
3. Creating a clean and healthy environment inside the building -- through material selection, dirt collecting mats, dust control and filters, and low VOC cleaning products.

Human Comfort --

- Appropriate thermal conditions (temperatures, relative humidity)
- Effective lighting levels (natural and auxiliary)
- Appropriate acoustical and vibration conditions (controlled noise pollution)
- Connection to natural environment; views, natural light, natural ventilation

The following items are derived from information published by the Healthy House Institute. They should be used to form the basis for green remodeling project goal-setting on indoor environmental quality improvements. A "golden rule" for reducing pollutant source strength is to: *eliminate, separate, and ventilate.*

Eliminate:

- Select construction materials, finishes, and trim materials that have lower levels of off-gassing.
- Avoid bulk moisture (rainwater) entry into building components by creating an effective rain-screen.
- Repair existing foundation walls so defects do not permit large amounts of soil-gas into home.*
- Construct an effective air-leakage barrier against soil gases such as radon below concrete floor slab, and to isolate conditioned areas from crawl space air.*
- Reduce use of wall-to-wall carpeting that acts as a reservoir for pollutant materials and increases home maintenance costs.

Separate:

- Employ effective isolation methods -- such as non toxic coatings, etc. -- to cut off emissions of irritating, hazardous or toxic materials from indoor air spaces
- Some activities generate more moisture or other pollutants and may be isolated from the rest of the living spaces in a home (kitchen with separate exhaust fan, laundry or mechanical rooms) with vents.

Ventilate:

- Build or remodel in an airtight manner to control the infiltration of polluted air from outdoors
- Provide a controlled supply of fresh air at all times, while removing stale air from living spaces
- A mechanical air filtration system can assist in reducing levels of particulate material -- such as dust, animal dander, and dust-mite allergen -- generated indoors by occupants
  - A mechanical air filtration system can assist in reducing levels of pollution brought indoors with the ventilation air or by uncontrolled air-leakage in the building shell
  - Provide more powerful exhaust fans in rooms where pollutants or moisture are generated

** denotes: probably not necessary or installed for Baltimore Rowhouse renovations*

3B.2 Minimize Indoor Pollutants

Indoor air quality and conditions can sometimes be worse than outdoor air! The affects of indoor pollutants on health can range from little impact on the occupants except an occasional headache or allergic reaction at certain times of the year, to severe allergic reactions, lung and other diseases and even toxic chemical reactions in extreme cases. And, since we spend so much time in our houses, especially sleeping, the indoor pollutants can be a source of high aggravations and adversely impact the health of the occupants. It is also important to know how to operate and maintain a house so it can remain healthy. Avoiding activities and practices that add to indoor pollution in a home can improve comfort and health dramatically.

The following list of indoor pollutants can be generated by a variety of sources including:

- Particulate matter such as dust, dirt, tobacco or cooking smoke
- Organic matter such as mold or other plant spores, dust mites, dander from pets,
- VOCs (Volatile Organic Compounds) from petrochemical, building and cleaning materials,
- Gases such as carbon dioxide, cooking orders
- Harmful substances or lead in water,
- Pathogens and microbial materials.

There are two major strategies for minimizing indoor air pollutants. The first is to minimize the creation and release of the pollutants by specifying low VOC paints, carpet, adhesives and furnishings, entrapping particulates in walk-off mats, using low VOC cleaning supplies and frequently using a quality, filtered vacuum cleaner.

The second strategy lies in providing plenty of fresh air to dilute the indoor air pollutants and ventilating bad air at the source directly to the exterior. Both of these strategies should be well balanced with the strategies to reduce energy use, and with overall budget of the project.

3B.3 Environmentally Friendly Building Materials and Interior Finishes

The extensive remodeling of homes is an opportunity to ensure a higher standard of indoor environmental health of homeowners and occupants. Some occupants of Baltimore row homes have very likely been exposed to sub-standard indoor health conditions in their homes. A healthy home can help in the long-term recovery process from such exposures and limit future exposure or hazards to the occupants, while contributing to the development of a healthy resource base.

Selecting interior finishes such as paint, floor coverings, or cabinetry is an important way to reduce indoor pollutants, and minimize the use of ozone generating materials ". The following practices are recommended:

1. Specify low VOC paints, flooring, adhesives and furnishings
2. Use formaldehyde free products (many manufactured wood materials, such as plywood or particleboard have formaldehyde in their glues)

3. Use CFC-free refrigerants in mechanical equipment
4. Follow product selections for low or no VOC products
5. Inert materials (e.g., enameled or stainless steel, ceramic tile, glass)
6. Non-toxic insulation materials
7. Install a walk-off mat at entrances with a rough surface traps dirt
8. Instead of wall-to-wall carpeting, use throw rugs and install finish surfaces that are dust free and easy to clean, such as hardwood or tile
9. Provide operable windows in all wet areas or direct mechanical ventilation

3B.4 Daylighting for Comfort and Health

Clean, dry and properly cooled or heated homes engender a sense of health and well being to the occupants. The admittance of plenty of unfiltered natural daylight, or sunlight is important to human health. There are several good reasons for accentuating daylight in homes.

Studies show people respond to higher levels of natural light indoors with a greater sense of well being and improved ability to focus their attention on tasks, conversation and learning activities.

The color of light admitted into spaces also plays an important role in adding to an occupant's sense of well being. Plants are not the only organisms that are "selective" to the spectral quality of lighting. Simply put, a light's color is directly related to the temperature of the light, hence the higher the lighting "temperature" often means the better the "color rendering" of objects in direct view. Sunlight coming directly through a window has a better color rendering that the lower temperature (poorer color quality) light from an incandescent bulb, for example. This is one reason people get more tired feelings reading under poor quality electric lights than when sitting in a brightly sunlit space. For people subject to seasonal affected disorders -- such as tending toward mild depression during winter months when sunlight is less -- providing more natural daylight can be a real boon and works on the physiological level.

Daylight helps keep dampness down by allowing areas to dry out and bacteria from growing. This finding dates back to European urban health campaigns starting in the late 18th century to re-design residential apartments to admit a reasonable amount of sunlight. Prior to that time poorer working people had been living in spaces with no natural light and ventilation, leading to poor health -- such as skin conditions (low Vitamin D), infectious respiratory mold and bacterial conditions. Admission of natural sunlight became law in London, England, by the beginning of the 19th Century.

However, natural daylight must be balanced with energy performance. Flat, roof mounted skylights are not particularly recommended for Baltimore's climate, due to heat generated in summer (*may transmit excess solar radiation, boosting A/C demand*) and the tendency toward leaking rainwater. A flat laying skylight can increase the air conditioning costs of a home. It is better to design skylights carefully to balance lighting and heat loss issues. Useful approaches to bringing natural daylight into a home with minimal energy efficiency impact include:

- Tubular skylights also called "sun tubes" bring daylight in through a small (8," 12" or 18" diameter) circular collection dome (appears outside like a translucent bubble), then transmit the collected light through a polished high-reflectance tube down into the building. Once the light reaches the home interior, it is distributed via a specially designed diffuser cover that permits a wider area of lighting than the direct gains coming through a traditional skylight. Tubular skylights are often installed in bathrooms, hallways and kitchens
- Light Monitors - Vertical, shaded glazing oriented to maximize the sunlight without the heat gain. Particularly useful over stairs and
- Clerestory windows – windows high in the wall above doors but must be shaded in the summer
- Basement light wells – carving out the ground plane from directly in front of the basement window and then lining with light colored stone or paving to bounce more light into the basement.
- North facing windows – if possible – let in a very even light that adds little to know cooling loads, but north facing windows need to be better insulated to reduce heat loss during winter weather

If the orientation of the house does not easily allow natural daylight, then install color corrected fluorescent lighting with a temperature range of 3800K or greater, to mimic natural daylight or have grow lights around plants.

3B.9 Security

Feeling safe and secure in a home is part of sustainable design also.

Security Illumination -- Exterior lights on motion-detecting sensors in the rear is a good idea as are electronic security systems. Another energy-saver is to install exterior lights on a photo-sensor that turns on after dark.

Active Deterrence -- bars on windows and exterior doors are sometimes essential. These systems must be constructed in a way that insures home occupants can escape the building during an emergency. This means some kind of hardware to release the lock from inside the dwelling, and not having these types of bars padlocked. This is a code requirement that is often circumvented.

Fire protection -- Small general purpose "ABC" type fire extinguishers should be located on each floor of the house, preferably near the stairs or stove, where they can easily be reached in an emergency.

Fire Safety -- Smoke detectors are now required to be permanent and wired into the electrical system.

Each household should have a fire escape plan, especially if there are small children and should be practiced with the children. The local fire station can assist with devising such plans also.

Community Building -- Of course one of the best ways to secure one's home is to have a safe neighborhood through knowing your neighbors and working together in neighborhood associations or watches, good relations with the local police and in minimizing abandoned properties or areas where people can lurk unseen.

3C Efficient Resource Use and Reduce Consumption

Beyond building with energy efficiency in mind, other conservation measures can profoundly affect a project's impact on the environment. Three key areas were identified for the Green Building Template. Those are: use earth-friendly materials and salvaged or recycled content materials, conserve water, and practice ecycling on the project both during demolition and construction and for post occupancy.. These are detailed in the sections below.

3C.1 Use Earth-Friendly Materials

Criteria for selection

Materials selection is a complicated process of research, weighing alternatives, and using common sense. The classic three criteria used by architects are: durability, cost, and availability. With green building, many more considerations come into play. For instance, green designers look at the entire life cycle of a material, including raw materials, manufacture, transport, installation requirements, and disposition at the end of its useful life. The following list provides some guidance. Since very few modern building materials satisfy all criteria, the idea is to look for a balance. Materials should be:

- Clean and nonpolluting
  Don't contribute to global warming, ozone depletion, acid rain. For example, materials that contain polyvinylchloride (PVC) may be avoided, due to the negative environmental impacts of its manufacture. Refrigerants containing hydrochlorofluorocarbons (HCFCs) are known to contribute to ozone depletion and should be avoided.

- Healthy to humans and domestic animals
  When researching a material or product, ask for the "Material Safety Data Sheet" (MSDS), which gives details on the major components of that material, and whether it is safe. Installation and finishing of a material should also have no negative affect on indoor air quality.

- Resource-efficient
  This includes low "embodied energy," recycled content, and contribution to energy efficiency. Varying amounts of energy go into the manufacture of materials. For example, aluminum takes 126 times more energy to process than wood. Recycled content reduces embodied energy as well as saving valuable materials from landfills. A light-colored roof actually reduces energy use by reflecting heat away from the house in the summer.

- Renewable
  Favors organic materials that are fast-growing, such as straw, bamboo, or cork

- Natural
  Favoring minimally-processed materials over synthetic organic compounds, many of which contain hazardous or carcinogenic components.

- Recyclable
  Materials that can be recycled, or, better yet, simply reused, when they are removed

- Locally obtained
  Decreases fossil-fuel burning for transport and supports local economies

- Durable and easily maintained
  Includes strength, resistance to decay or pests, ability to withstand exposure to UV light, and ease of maintenance without use of toxic chemicals.

(adapted from Eco-Renovation)

The Green Building Template includes a listing of greener alternative building materials and their sources in the Baltimore region. See Appendix B2.

Salvaged and Recycled Materials

Salvaged materials are a great way to save money and resources. This may include refurbished materials, purchasing seconds or manufacturers overstock, reused equipment or remanufactured items such as paint. Each of these materials saves resources and energy by skipping the extraction step and not using virgin materials. Search for salvaged materials at www.recycle.net. Some building materials are available locally at the Loading Dock (410) 728-3625.

Sources for some recycled-content materials are listed on EPA's website: www.epa.gov/cpg or call RCRA Hotline at 800 424-9346. This is part of EPA's Comprehensive Procurement Guideline (CPG) to assist customers interested in purchasing and using products containing recovered materials. Some manufacturers provided the names and locations of regional or local suppliers. Common materials included on this list are: building insulation, carpeting and pads, concrete-coal fly ash, floor tiles, shower and restroom dividers, and structural fiberboard.

3C.2 Conserve Water

Water usage is another substantial area for savings. Water in this country is fairly inexpensive ($1.76 per 1,000 gallons – RMI *Homemade Money*, p. 64) to consumers but does not reflect the hidden cost that shows up in property taxes and pollution from the energy required to pump, treat and deliver the water to our homes and business. Consequently we waste considerable amounts of water that could easily be conserved. In addition, we waste energy through inefficient heating for domestic hot water heating. In the "rain-rich" east coast area, it is hard to imagine running out of water. But potable water is one of our most precious resources and is subject to varying levels of availability and quality. In recent years we have experienced drought conditions, low aquifer levels and quality problems from ageing city infrastructure that can pose public health risks. Perhaps the most compelling reason for water conservation in Maryland is to minimize wastewater flows into these ageing systems and to protect the water quality of the Chesapeake Bay and its watershed.

Water Use in Typical Household

The average household in the Chesapeake Bay watershed uses between 75 and 100 gallons of water per day per person (source: US Census 2000 website, www.us-census.org/ from *EBN* "Buildings and the Numbers" Article p. 10 May 2001). For a family of four, this is an annual consumption rate of over 100,000 gallons per year of potable, clean water for internal domestic use only. This does not include outdoor irrigation, watering, gardening or pool usage, nor does it include indirect commercial or industrial uses of water for the production of building materials. Approximately half of all water used within the home flows through the bathroom. Our bodies only need about 4 gallons a day to survive and about 30 gallons to match our current style of living.

From a 1999 study by the American Water Works Association (AWWA) Research Foundation: the Mean Annual Water Use is 146,500 gallons per household per year for both outdoor and indoor use (Median = 123,200 gallons). The average percentage of inside use (42%) to outside use (58%) seemed fairly constant but varies according to local climate. (From AWWA of 1,188 study homes in 12 sites around the USA at www.waterwiser.org). Outdoor water usage for the Baltimore Rowhouse type will be fairly limited due to the small backyard space. However, even a modest or small leak in the either the piping system or a faucet, can dramatically increase the water consumption of a household. A family can calculate an estimate of their water usage by keeping a water diary for a few days using the following chart:

GBT Recommendations for Water Conservation

Most of the water saving features we have selected are comparable in price to good quality fixtures and faucets. They are not the cheapest on the market, and homeowners should look for durable, quality pieces that also have standard, easy to acquire replacement parts. Except for composting toilets, which require no water, none of the new technologies require any changes in installation or inspections. The newer "low-flow" fixtures have also, through better engineering and product design, overcome many of the shortfalls earlier models demonstrated including designing valves to keep the pressure level up while using lower water flow rates.

1. Specify low flow, well designed and durable faucets, fixtures, and appliances
2. Opt for durability and simplicity over lower initial costs
3. Carefully plan the location of Domestic Hot Water heaters (DHW)
4. Install rainwater collection barrels for watering plants

To elaborate on the third item, the DHW should be located as close to the point of use as possible. DHW's account for 12% to 17% of a home's energy use. It is usually the next highest energy user after heating or cooling the home. Most of the energy use goes into storing and keeping the hot water "hot" and available. Several simple ways to save energy with your hot water heater is to:

- ✓ Wrap the pipes and the hot water tank with insulation, be sure to insulate the top and install a bottom board of insulation if DHW is placed on a concrete slab on grade.
- ✓ Keep pipe runs to a minimum
- ✓ Set the water temperature to 120^{O} F instead of 140^{O} F. This could save 15% the cost of running the water heater over the course of a year. Caution: settings lower than 120^{O} F create a risk of bacterial growth such as Legionella.

Gas DHW's are more efficient and should be selected on the basis of their EF or efficiency factors. The 1990 appliance energy standards calls for a 0.51 to 0.56 EF depending on size with larger (60 gal) hot water heaters being a little less efficient. When selecting a hot water heater, pay special attention to the life-cycle costs. The lower first time cost of electric hot water heaters can cost plenty in lifetime operational cost. It may cost as much as $450 per year to operated a "cheaper" electric hot water heater. Select the smallest size tank the household can live with unless an integrated (heating and hot water) system is installed. Also have the plumber install anti-convection valves and be sure to insulate both hot and cold water pipes for at least three feet out from the tank.

Baltimore City water and sewer rates for residential properties are approximately $3.00 per 1,000 gallons for water and $4.33 per 1,000 gallons for sewer. Typical water usage for a Patterson Park renovated unit located at 34 N. Linwood was 43 gallons per day or about 15,500 gallons per year for the household. The total water and sewer costs for this household was $117.62 and is based on actual bills provided by the homeowner. PP-CDC put in low flow toilets and faucets which could account for the over 50% savings in water use per day than an average household (75 gpd per household). The house could also have a below average number of occupants.

Tankless or demand-type hot water systems greatly reduce energy use as well as conserving water. They heat water only as it is called for, so there is no storage and reheating of water. They are very effective, eliminating the waste of water at the tap while waiting for it to become hot. The most efficient fuel source is natural gas or propane; electric demand heaters can consume a lot of electricity.

Terms and Notes

gcd – gallons per capita per day
gpm -- gallons per minute
gpd – gallons per day
gpf -- gallons per flush

Rainwater Collection

Another way to conserve water is to collect rainwater from the roof. In some parts of the world, including Australia, collected rainwater is used for drinking and bathing. In Baltimore, it is more common to use rainwater for plant

irrigation, saving city water for drinking. Rainwater collection barrels, sometimes called rain barrels, come in a variety of sizes and costs. Ready-made barrels can be purchased (see Material Matrix in Appendix B2). It is also fairly easy to make one. A simple rain barrel is described on the Maryland Green Building Program website: www.dnr.state.md.us/programs/greenbuilding/rainbarrel.html.

3C.3 Recycling Opportunities

Recycling and Composting in the Home

The average person in the USA generates approximately 4.3 pounds of solid waste, (trash or garbage) per day! (source: The Consumer's Guide to Effective Environmental Choices) This adds up to 1570 pounds per year. Recycling household waste is a key element in creating sustainable communities. Fortunately, Baltimore City has a convenient and extensive recycling program. Kitchens can be designed to facilitate the homeowner's participation by including bins for storing recyclables separate from trash.

If a homeowner is amenable, a small composting program can be a practical and earth-friendly alternative to a kitchen sink disposal unit. Sink disposals send valuable organic matter down the drain into our already over-burdened municipal sanitary treatment system. Alternatively, composting uses nature's own bacteria and other life to break down kitchen scraps into valuable compost. The website listed for the Urban Rain Barrel in the "Sources" section of Appendix B also sells small-scale composters that fit neatly into a small backyard space. Various units retail for $70 to $140. A book on backyard composting is available for $7.00.

Recycle Construction & Demolition Waste (CDW)

In the State of Maryland, there is growing concern about the increasing amounts of CDW that is going into the landfill or being processed through Municipal Solid Waste programs. Nationally, about 40% of the landfill space is taken up with mixed construction debris. There is a move toward greatly lowering this quantity through recycling, "deconstructing" buildings, and increasing the amount of salvage materials recovered from demolition sites. In addition, the construction process generates significant quantities of waste material such as scrap, packaging, and inefficiently-used materials. Recycling CDW saves energy, landfill space and encourages creative reuse of materials.

Demolition Phase

For the GBT, we have briefly looked at how much waste material is generated during a typical renovation and have made a few recommendations on reducing this amount. Each renovation is going to be different, but for the GBT we assumed the following:

- demolition of most of the interior plaster walls (550 SF)
- replacement of damaged plaster ceilings (400 SF)
- no new roof is installed so little roof waste other than that used in patching and repairing.

Plaster weighs between 10 and 20 pounds per square foot generating approximately 6 to 10 tons of construction debris per house renovation. A five yard dumpster could easily handle this quantity of material. However, reducing this amount can save money in tipping & hauling fees and or offset demolition costs through better more salvage material suitable for selling. Tipping fees at the Quarentine Road Landfill, Baltimore City's landfill are approximately $67.50 per ton of debris, unsorted. There is not recycling or C+D waste recovery at this landfill.

According to Jim Shetler of Patterson Park CDC, an allowance of $1,500 dollars is included in each project for demolition related expenses and approximately $4,000 to $5,000 for the demolition contractor's time and labor. The $1,500 primarily covers tipping and hauling fees, the permit and dumpster rental if required by the project. Debris is taken to the Baltimore city landfill.

PP-CDC currently does not have a construction and demolition recycling program nor are waste materials sorted. Doors, sometimes windows, and piping material are salvaged for reinstallation or sale. If tin ceilings are found in the houses, they are usually cleaned up and repainted. There is very little salvage value in the houses other than what is noted above. Generally there is little wood salvaged.

Either the structure is adequate and left in place or the plaster interior walls cannot be cost effectively disassembled to salvage the studs. If a contractor was replacing all floors and joists, then there might be some wood salvage value. Generally, construction waste is moderate throughout the construction period due to fairly small amounts of packaging materials, relatively few walls are constructed and there is little concrete or masonry work done on these types of projects.

Construction Phase

During construction, scraps, packaging, and other leftover materials can be recycled. A program of separating materials should be set up at the beginning of the project, and contractors and their subs need to be trained and monitored. Typical materials being recycled include metals; clean dimensional wood; plywood, OSB & particle board; concrete; CMUs; bricks; gypsum wallboard; rigid foam insulation; paint; window glass; carpeting and pads; asphalt shingles; polystyrene; and cardboard, paper & packaging. In the Baltimore region, the most commonly-recycled materials are concrete, asphalt, brick, metals, corrugated cardboard, and wood.

Sources:
1998 Maryland Construction and Demolition Materials Recycling Directory, prepared by MDE. To order, 800-735-2258. Directory contains listings for all the commonly-recycled materials, as well as many others.

Residential Construction Waste Management: A Builder's Field Guide, published by the NAHB Research Center. To order, 301-249-4000. Emphasis on new residential construction, but much is applicable to renovations. A publication geared towards remodeling waste management is also available.

The California Integrated Waste Management Board has a program that is well-documented on their website: www.ciwmb.ca.gov/ConDemo/ The link to Publications is full of great information.

3D Operations and Maintenance

There are several strategies to make these houses easy to operate and maintain. These include selection of materials that are durable, requiring little or no maintenance. Publishing simple homeowner guidelines, in the form of a "user's manual" for the house's primary features, can be very effective. Education and training programs, such as in the proper use of a programmable thermostat, can also be effective in helping home occupants achieve the modeled energy performance goals. Other information, such as how to compost kitchen scraps or to collect and use rainwater, can also lessen the environmental impact of the project. These strategies can easily be addressed in a later implementation phase of the Template.

3E Site and Community Issues

These include mitigating the urban heat island effect with light roof color, planting trees, and reducing impervious (paved) outdoor surfaces. Both CDC's are already working towards job creation in the construction trades, which could be extended into weatherization and home energy rating as this project progresses. There is also opportunity for developing a construction waste recycling program serving the neighborhood and beyond.

Landscape greening is very appealing for many reasons, but can be at odds with homeowner needs. A backyard garden requires upkeep, while a paved area needs very little. Street trees add a tremendous amount of ambiance, not to mention value, to a block. Tree-lined streets are more inviting and cooler than those with no trees. It is important to understand why trees were removed historically, as well as to identify species that are compatible with an urban environment.

As there is a two to three year wait for the city to plant trees, some neighborhoods have started their own nursery and planting programs. A great example is the Hollins Street tree nursery at 1224 Hollins (corner of Hollins and Carey Streets) in Southwest Baltimore.

Gary Letteron has been involved with that for several years. His contact information is 410-625-1751, email glue39@bcpl.net. Parks and People Foundation is also very active with community gardening throughout the city. Contact Guy Hager at 410-396-0198.

Cultural expectations – what's "normal" for a community – are also an important consideration that feeds into homeowner education. Certain expectations may be at odds with some of the environmental goals – for example, the perception that vinyl windows are a superior "space-age" product. Developers often know their market best, and that sort of feedback is important to developing a usable Green Template.

- Build or remodel in an airtight manner to control the infiltration of polluted air from outdoors
- Provide a controlled supply of fresh air at all times, while removing stale air from living spaces
- A mechanical air filtration system can assist in reducing levels of particulate material -- such as dust, animal dander, and dust-mite allergen -- generated indoors by occupants
- A mechanical air filtration system can assist in reducing levels of pollution brought indoors with the ventilation air or by uncontrolled air-leakage in the building shell
- Provide more powerful exhaust fans in rooms where pollutants or moisture are generated.

Section 4 Green Template Matrix and Worksheet – Light, Medium, and Deep Green Alternatives

4A Overview of the Matrix Summary Organization

Three packages were developed which contained upgrade measures capable of producing three levels of performance -- good, better, best (or, Light, Medium, and Deep Green). These proposed packages were subjected to energy-efficiency ratings and cost analysis to produce the Template.

Each of the three alternates – Light, Medium, and Deep Green – is described in terms of assemblies, rather than individual materials. This approach was used for the Emeryville reSourceful Building Project (see "Related Initiatives" in Section 2). These assemblies are organized in the following categories:

A. Exterior walls (front and rear)
B. Party walls (side walls between rowhouses)
C. Roof assembly
D. Windows and doors
E. Interior assemblies and finishes
F. Appliances and equipment
G. HVAC systems
H. Plumbing
J. Lighting and Electrical

In the summary matrix, the assemblies of the Base Case house are included in the first column, with the alternates listed in the next columns reading across. This allows comparisons between the typical renovation and each of the alternates, as well as comparison between alternates.

4B Light, Medium, and Deep Green Alternates: Energy Performance Analysis

4B.1 Description of the Alternatives

Light Green --

The "good" level package was termed in the analysis as "Light Green." We mean here that this package provides good entry-level energy performance well above the basic levels now being installed in renovated Baltimore row housing. This option emphasizes improving energy performance for the least first cost possible. It was designed to create energy performance similar to that found in new homes meeting current building code requirements for energy efficiency in Maryland. Thus, the buyer of a "Light Green" renovated row home would be no worse off on relative energy bills than someone who was purchasing a new single-family home elsewhere. The target for added first cost was 0% to 2%.

Medium Green --

The "better" package was termed in the analysis as "Medium Green." We mean here that this package provides a mid-level of energy performance significantly above the basic levels now being installed in renovated Baltimore row housing. The Medium green package was developed specifically to meet US EPA *EnergyStar™* Homes standards for new construction. It represents a performance level that is about 30% better for heat, A/C and hot water energy use, than a home meeting 1992 "Model Energy Code" levels cited as the National benchmark in the revisions to the US Code - *National Energy Policy Act of 1992*. The target for added first cost was 2% to 5%.

SECTION 4: Green Template Matrix - Costs and Alternatives

Deep Green --
The "best" package was termed in the analysis as "Deep Green." We mean here that this package provides a high-level of energy and environmental performance very much above the basic levels now being installed in renovated Baltimore row housing. It also includes several materials that are superior environmentally. In this case, the analysis projected an energy efficiency rating of over 90, which means a "Five-star Plus" home. This performance is at the top level of home energy efficiency, and requires integrated design of passive solar, tight air-sealing, super efficient HVAC, etc. This level of performance is superior to the advanced building technology demonstration homes being created in the US Department of Energy "Building America" program, where the energy efficiency target is for a 50% or better reduction in building energy use. The target for added first cost was 7% to 10%.

4B.2 Summary Alternatives Table

This section reviews the major features of each energy package level. While certain features of the green alternates might be considered optional, these items must be retained if the modeled energy performance is to be met.

Table ____ Major Energy-efficiency Features by Design Scenario

Feature	Base Case	Light Green	Medium Green	Deep Green
Insulation				
- Roof	R-30 FGB	R-24 LB cellulose	R-38 "dense pack"	R-31 AirKrete
- Walls	R-11	R-11 Stab cellu'	R-19 steel stud	R-19 AirKrete
- Basement wall	Un-insulated	R-11 FSB	R-11 FSB	AirKrete 2"
- Party Walls	Un-insulated	sheetrocked	Firing, cellulose	R-5.5 AK, GWB
Roof surface	BUR recoat	BUR White acry	Mod Bit. Light color	"Green Roof"
Windows	DP vinyl	Vinyl Low-E	Alum TB Low-E	FG Low-E Argon
Skylights	Clean up	Retro dbl Pane	Retro dbl Pane	Solar Tubes
Doors	Standard	R-4 improved	R-4 improved	R-5 super-insul
HVAC				
- Heating	AFUE 78	AFUE 84	AFUE 91	Combo-unit FA
- Cooling	SEER 11	SEER 11	SEER 13	SEER 15
- Hot Water	Standard	"Efficient" gas	Demand htr, gas	Combo/solar HW
- Ducts	Sheet mtl,	Duct seal, good	Duct seal <10% lkg	Tight sealed
- Ventilation	Bath fans	Bath fans	Bath fans, timers	Bath & Kit / timers
Thermostat	Standard	Digital	Digital (2)	Digital (2)
Ceiling Fans	Pre-wired	LR, DR, Kitchen	LR, DR, Kitchen	LR, DR, Kitchen
Appliances				
- Stove	Std	Outside venting	Elect. Ignition, OV	Elect. Ignition, OV
- Refrigerator	Std	EnergyStar	EnergyStar	"Eco-Fridge"
- Microwave	By owner	By owner	By owner	E*/range hood
- Dishwasher	Std	Std	EnergyStar	EnergyStar
- Laundry	Std	Std	EnergyStar	EnergyStar
Lighting package	Standard pkg	Some flouresnt'	Pin-base CFL's	Pin-base CFL's
Water Savings	NAECA	LF Shower head	Better toilet, LF SH	Dual flush toilet

Additional detail may be found in the extensive entries in the worksheet "Matrix" information on each respective package.

SECTION 4: Green Template Matrix - Costs and Alternatives

4B.3 Energy Simulation Results for each alternative & Energy Analysis Table

The base case energy simulation results compared favorably with billing data compiled for a typical row house in the Patterson Park CDC customer base. The utility bills totaled $989 for a year's fuel and electric power consumption, while the projected utility bills for the computer-modeled base case row house totaled $1003 per year. This agreement is better than in most comparisons of utility billing data and computer predictions that have appeared in the literature.

The three packages discussed previously were analyzed by the same software that was used to determine the base case energy performance of the example row house. We used the Architectural Energy Corp. REM/Rate Version 10.0 software for this purpose.

Light Green --

Compared to the base case (HERS score 74.8) the energy efficiency for the light green model was improved to an "80" score, roughly equivalent with the expected efficiency of a new home built to current code in Maryland. A 21.6% overall savings was indicated compared to base case, with the predominant savings coming from better space heating performance due to increased insulation and better furnace efficiency. The light green home overall used $89.00 less energy per year than the base case home predictions indicated.

Medium Green --

Compared to the base case (HERS score 74.8) the energy efficiency for the medium green model was improved to an "88" score, slightly better than the expected efficiency of a new home built to meet the US EPA EnergyStar Homes criteria (HERS score 86 or better). A 44.7% overall savings was indicated compared to base case, with the predominant savings coming from heating, air-conditioning and some from hot water due to changing to a "demand-heater" for hot water. The medium green home overall used $255.00 less energy per year than the base case home predictions indicated.

Deep Green --

Compared to the base case (HERS score 74.8) the energy efficiency for the medium green model was improved to an "90.4" score, much better than the expected efficiency of a new home built to meet the US EPA EnergyStar Homes criteria (HERS score 86 or better). A 72.2% overall savings was indicated compared to base case, with much of the savings coming from better insulation, air-tightness, and super efficient HVAC approach. The deep green home overall used $650.00 less energy per year than the base case home predictions indicated.

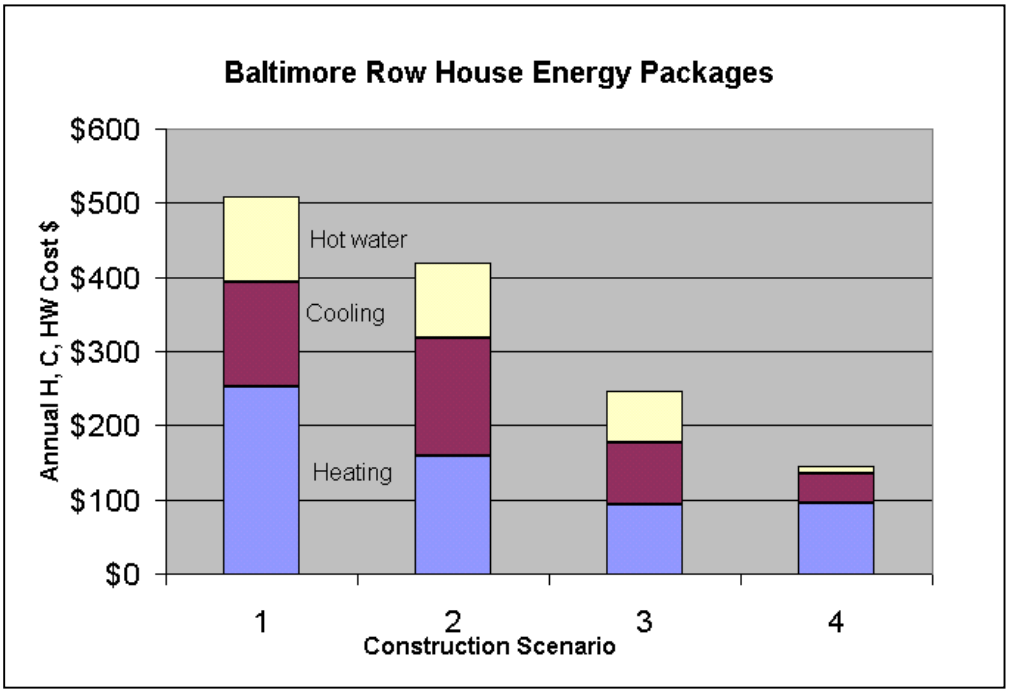
SECTION 4: Green Template Matrix - Costs and Alternatives

Table ___ Energy Performance Predictions and HERS Scores

Construction Scenario (updated 10-20-2001)	HERS Rating	MMBtu/yr Total Energy/Yr	Energy Star Rated Loads			Annual ESL $	Lighting & Appliance $	Service Charges $	Annual Utility $
			Heating $	Cooling $	Water Htg $				
1. "Base-case"									
As Proposed PP-CDC example	74.8	95.7	$253	$141	$114	$508	$375	$120	**$1,003**
	80.0	75.0	$158	$159	$102	$419	$375	$120	$914
2. Light Green GBT Level HERS 80									
Savings V base case		20.7	$95	-$18	$12	**$89**			
Percentage Energy Savings		**21.6%**							
	88.9	52.9	$94	$82	$71	$247	$381	$120	$748
3. Medium Green GBT Level HERS >86									
Savings V base case		42.8	$159	$59	$43	**$261**			
Percentage Energy Savings		**44.7%**							
	90.4	26.6	$96	$40	$9	$145	$88	$120	$353
4. Deep Green GBT Level HERS 90									
Savings V base case		69.1	$157	$101	$105	**$363**			
Percentage Energy Savings		**72.2%**							
Utility billing data, 34 N. Linwood									**$989.08**

SECTION 4: Green Template Matrix - Costs and Alternatives

Figure ___ Baltimore Row House Energy Package Comparison



4C Light, Medium, and Deep Green Alternates: Cost Evaluation Worksheet

This worksheet is used to calculate the additional first costs for each of the alternates. This analysis is intended to assist the CDC in evaluating the feasibility of the energy and environmental performance measures.

Each worksheet is organized in the same way as the summary matrix. The assemblies run down the second column, with the upgrade items described in the third column. The added cost per unit is shown in the fourth column. Note that units vary, depending upon the assembly or material that is being evaluated. The units are shown in the fifth column. Units are either by square foot area (SF) of a surface, such as a roof or wall; by quantity (EA) for individual items such as an appliance or windows; or by linear foot (LF) for trim. The sixth column is outlined in red, indicating numbers to be filled in. The spreadsheet calculates the costs based on the amounts or areas that are entered into this column. Prompts in red text act as a guideline for the type of data (areas or quantities) that are to be entered. At the end of the worksheet, if the typical or base case budget is entered, the spreadsheet will calculate the percent increase in first cost for the green alternate.

In the spreadsheet file, there are six tabs: three “clean” versions, with no data filled in, and three demonstration versions, using the house at 24 N. Kenwood as the typical base case renovation.

SECTION 4: Green Template Matrix - Costs and Alternatives

The following section contains the Matrix worksheets for the Base Case and Light, Medium and Deep Green Alternatives

LIGHT GREEN GBT MATRIX

		Meets MEC 92 for new home			FILL IN	
	ITEM	**Light Green Upgrade HERS 80**	**ADDED COST**	**UNIT**	**AREA or quantity**	**TOTALS**
		Qualifies for Energy Star Home				
A.	**Exterior Walls**				Enter wall	
	Exterior Walls - Front / Rear at 1st & 2nd Floors				area here	
	Structure	Brick masonry, existing				$0.00
	New Int Framing	2 x 4 certif wood at 16" o.c.	$0.00	SF		$0.00
	Insulation	R-11 Cellulose blown-in	$0.20	SF		$0.00
	Vapor retarder	VR paint on interior	$0.07	SF		$0.00
	Interior sheathing	1/2" GWB				$0.00
		Subtotal Cost	**$0.27**	**SF**		**$0.00**
					Enter wall	
	Exterior Walls - Front & Rear Basement				area here	
	New Int Framing	None				$0.00
	Insulation	Min R-11 foil face drape 1/2 wall	$0.54	SF		$0.00
	Vapor retarder	see above				$0.00
	Interior sheathing	no				$0.00
	Rear Exterior Finish	Brick existing				$0.00
		Subtotal Cost	**$0.54**	**SF**		**$0.00**
		TOTAL ADDED COST A.				**$0.00**
B.	**Party Walls**				Enter wall	
	Side Walls (Party Walls) Assembly - 1st & 2cd floor				area here	
	Structure	Exist'g brick - 8" thk (4" to PL)				$0.00
	Framing	Repair existing furring				$0.00
	Insulation	none, except near corners	$0.36	SF		$0.00
	Interior sheathing	1/2" GWB				$0.00
		Subtotal Cost	**$0.36**	**SF**		**$0.00**
					Enter wall	
	Side Walls (Party walls) Assembly - Basement				area here	
	Structure	Brick masonry, existing				$0.00
	Int framing	none				$0.00
	Insulation	none	$0			$0.00
	Interior sheathing	no				$0.00
		Subtotal Cost	**$0.00**	**SF**		**$0.00**
		TOTAL ADDED COST B.				**$0.00**
C.	**Roof Assembly**				Roof area	
	Roof framing	Existing - assume 2 x 8			or quantity	
	Ceiling framing	2 x 6 wood				$0.00
	Insulation	R-24 loose blown cellulose	$0.16	SF		$0.00
	Vapor retarder	Seal joints, VR paint interior	$0.04	SF		$0.00
	Sheathing	OSB 5/8" over exist.	$0.71	SF		$0.00
	Roofing	B.U.R.- white acrylic coating	$0.10	SF		$0.00
	Roof ventilation	Goose neck	$30.00	EA		$0.00
	Finish interior	1/2" GWB				$0.00
		Subtotal Cost	**$1.01**	**SF**		
		TOTAL ADDED COST C.				**$0.00**

Assemblies Matrix

D.	**Windows & Doors**				Enter quantity	
	Windows	Vinyl low-E insulated glass	$24.00	EA		$0.00
	Front door	Insul. Steel (R-4)	-$185.00	EA		$0.00
	Rear door	Insul. Steel (R-4) w/ lites?	-$185.00	EA		$0.00
	Skylight	Retrofit Double glazing	$80.00	EA		$0.00
		TOTAL ADDED COST D.				**$0.00**
E.	**Interior Assemblies**					
	Basement Floor				Area or amt.	
	Floor seal, insulation	Exist'g conc, sealed		SF		$0.00
	Radon test	Yes; seal as appropriate		EA		$0.00
	First Floor Assembly				Floor area	
	Joists	Existing wood			here	
	Insulation	none				
	Sub Floor / Deck	Existing T & G wood		SF		$0.00
	Underlayment	Masonite		SF		$0.00
	Finish Floor - LR, DR	Refinish existing strip wd.		SF		$0.00
	Kitchen, Powder Rm	Linoleum	$2.20	SF		$0.00
	(Optional LR, DR)	Recycled PET Berber carpet		SF		$0.00
	Second Floor Assembly				Floor area	
	Joists	Existing			here	
	Finish Floor - Bath	Linoleum	$2.20	SF		$0.00
	Other rooms	Recycled PET Berber carpet		SF		$0.00
	Interior Finish Materials				See units	
	Paint	Low- VOC	$0.04	SF		$0.00
	Adhesives	Low- VOC		EA		$0.00
	Wall Tile	Reclaimed ceramic tile		SF		$0.00
	Trim	Finger-jointed wood?		LF		$0.00
	Counter tops	"Firecrete" cementitious bd.		SF		$0.00
		TOTAL ADDED COST E.				**$0.00**
F.	**Appliances/Equip**				Quantity	
	Stove	Standard		EA		$0.00
	Refrigerator	Energy Star, 18 CF	$0	EA		$0.00
	Microwave	by owner?		EA		$0.00
	Kitchen vent	Outside venting, 2-speed hood	$75	EA		$0.00
	Dishwasher	Standard		EA		$0.00
	Washing machine	Standard		EA		$0.00
	Dryer	Standard		EA		$0.00
	Cabinets	Wheatboard?		EA		$0.00
		Subtotal Cost	**$75**			
		TOTAL ADDED COST F.				**$0.00**

Assemblies Matrix

G.	**HVAC Systems**				Quantity	
	Heating	Forced Air, Gas 84 AFUE				$0.00
	Cooling	SEER 11 Condenser	$0			$0.00
		2 ton				$0.00
	Infiltration/Weather	routine weatherization				$0.00
	Ventilation	Same as base case	$0	EA		$0.00
	Ducting	Duct leakage < or = 10%	$175	EA		$0.00
	Water Heater (gas)	Upgrade efficiency	$125	EA		$0.00
	Thermostat	Digital clock thermostat	$75	EA		$0.00
	Fire Protection	None required; hardwired smoke detectors				$0.00
		Subtotal Cost	**$375**	**EA**		
		TOTAL ADDED COST G.				**$0.00**
H.	**Plumbing**					
	Water Supply	City			Quantity	
	Bathtub			EA		$0.00
	Shower	Water-saving head		EA		$0.00
	Sinks			EA		$0.00
	Toilet	1.6 G/F unit		EA		$0.00
	Kitchen Sink			EA		$0.00
	Outdoor spigot			EA		$0.00
		Subtotal Cost	**$0**			
		TOTAL ADDED COST H.				**$0.00**
J.	**Lighting & Electrical**					
	Service	100 Amp, new breaker panel			Quantity	
	Lighting	Fluorescent bulbs in std fixtures	$100	total		$0.00
	Ceiling fans	LR, DR, Kitchen (3 at $75 each)	$225	total		$0.00
	Garbage disposal	Same as base case				$0.00
		Subtotal Cost	**$325**			
		TOTAL ADDED COST J.				**$0.00**
	SUMMARY OF LIGHT GREEN PREMIUM					
		TOTALS OF ITEMS A. THRU J. ABOVE				**$0.00**
		Percentage of base case cost of			**1**	**0%**
					Budget cost	(Percentage
					fill in	formula)

MEDIUM GREEN GBT MATRIX

	ITEM	Medium Green Upgrade HERS ~86	ADDED COST	UNIT	FILL IN AREA or quantity	TOTALS
		Qualifies for Energy Star Home				
A.	**Exterior Walls**				Enter wall	
	Exterior Walls - Front / Rear at 1st & 2nd Floors				area here	
	Structure	Brick masonry, existing				$0.00
	New Int Framing	1-5/8" metal studs held 3" off brick	-$0.38	SF		$0.00
	Insulation	R-19 Stabilized cellulose filled	$0.60	SF		$0.00
	Vapor retarder	VR paint on interior	$0.45	SF		$0.00
	Interior sheathing	1/2" GWB		SF		$0.00
		Subtotal Cost	**$0.67**	**SF**		**$0.00**
					Enter wall	
	Exterior Walls - Front & Rear Basement				area here	
	New Int Framing	none required				$0.00
	Insulation	Min R-11 foil face, draped full	$0.54	SF		$0.00
	Vapor retarder	see above				$0.00
	Interior sheathing	none				$0.00
	Rear Exterior Finish	Parge exist masonry	$3.50	SF		$0.00
		Subtotal Cost	**$4.04**	**SF**		**$0.00**
		TOTAL ADDED COST A.				**$0.00**
B.	**Party Walls**				Enter wall	
	Side Walls (Party Walls) Assembly - 1st & 2cd floor				area here	
	Structure	Existing wall, crack control				$0.00
	Framing	1-5/8" mtl studs	$0.65	SF		$0.00
	Insulation	Cellulose blown in	$0.36	SF		$0.00
	Interior sheathing	1/2" GWB				$0.00
		Subtotal Cost	**$1.01**	**SF**		**$0.00**
					Enter wall	
	Side Walls (Party walls) Assembly - Basement				area here	
	Structure	Brick masonry, existing				$0.00
	Int framing	none				$0.00
	Insulation	min R-11 foil face, draped	$0.54	SF		$0.00
	Interior sheathing	none				$0.00
		Subtotal Cost	**$0.54**	**SF**		**$0.00**
		TOTAL ADDED COST B.				**$0.00**
C.	**Roof Assembly**				Roof area	
	Roof framing	Existing - assume 2 x 8			or quantity	
	Ceiling framing	2 x 6 wood				$0.00
	Insulation	R-38 "dense-packed" cellulose	$0.20	SF		$0.00
	Vapor retarder	Seal joints, VR paint interior	$0.04	SF		$0.00
	Sheathing	OSB 3/4" over exist.	$0.82	SF		$0.00
	Roofing	3-ply Modified bitumen w/ light coating	$3.50	SF		$0.00
	Roof ventilation	Turbine	$30.00	EA		$0.00
	Finish interior	1/2" GWB				$0.00
		Subtotal Cost	**$4.56**	**SF**		
		TOTAL ADDED COST C.				**$0.00**

Assemblies Matrix

D.	**Windows & Doors**				Enter quantity	
	Windows	Alum Th-B, low-E insul.	$85	EA		$0.00
	Front door	6-panel insul fiberglass	-$75.00	EA		$0.00
	Rear door	6-panel insul fiberglass	-$75.00	EA		$0.00
	Skylight	Retrofit Double glazing	$80.00	EA		$0.00
		TOTAL ADDED COST D.				**$0.00**
E.	**Interior Assemblies**					
	Basement Floor				Area or amt.	
	Floor seal, insulation	Radon seal up, crack control				$0.00
	Radon test	Yes; seal as appropriate				$0.00
	First Floor Assembly				Floor area	
	Joists	Existing wood			here	
	Insulation	none				
	Sub Floor / Deck	Existing T & G wood				$0.00
	Underlayment	Homosote 1.25" T&G	$2.20	SF		$0.00
	Finish Floor - LR, DR	Refinish existing strip wd.				$0.00
	Kitchen, Powder Rm	Linoleum	$2.20	SF		$0.00
	(Optional LR, DR)	Recycled PET Berber carpet				$0.00
	Second Floor Assembly				Floor area	
	Joists				here	
	Finish Floor - Bath	Linoleum	$2.20	SF		$0.00
	Other rooms	Recycled PET Berber carpet				$0.00
	Interior Finish Materials				See units	
	Paint	Low VOC	$0.04	SF		$0.00
	Adhesives	Low- VOC		EA		$0.00
	Wall Tile	Reclaimed ceramic tile	$2.50	SF		$0.00
	Trim	Formaldehyde-free MDF	$0.40	LF		$0.00
	Counter tops	Site-formed concrete		SF		$0.00
		TOTAL ADDED COST E.				**$0.00**
F.	**Appliances/Equip**				Quantity	
	Stove	Electronic ignition gas		EA		$0.00
	Refrigerator	Energy Star, 18 CF	$0	EA		$0.00
	Microwave	Efficient unit		EA		$0.00
	Kitchen vent	Outside venting, 2-speed hood	$75	EA		$0.00
	Dishwasher	Energy Star / Water efficient unit		EA		$0.00
	Washing machine	Energy Star / Water efficient unit		EA		$0.00
	Dryer	Energy Star efficient unit (gas?)		EA		$0.00
	Cabinets	Solid wood, non formaldehyde		EA		$0.00
		Subtotal Cost	**$75**			
		TOTAL ADDED COST F.				**$0.00**

Assemblies Matrix

G.	**HVAC Systems**				Quantity	
	Heating	Forced Air, Gas 91 AFUE				$0.00
	Cooling	SEER 13 Condenser	$750	EA		$0.00
		1.5 ton				$0.00
	Infiltration/Weather	ACH < 0.5 (0.35 target)	$250	EA		$0.00
	Ventilation	Provide timer on bath & Kit vents	$85	EA		$0.00
	Ducting	Duct leakage <10%	$175	EA	1	$175.00
	Water Heater (gas)	Demand (gas)	$320	EA		$0.00
	Thermostat	Digital clock thermostat (2)	$150	EA	1	$150.00
	Fire Protection	None required; hardwired smoke detectors				$0.00
		Subtotal Cost	**$1,730**	**EA**		
		TOTAL ADDED COST G.				**$325.00**
H.	**Plumbing**					
	Water Supply	City			Quantity	
	Bathtub	re-use, refurbish?				$0.00
	Shower	Water-saving head				$0.00
	Sinks					$0.00
	Toilet	Toto 1.6 G/F	$25	EA		$0.00
	Kitchen Sink					$0.00
	Outdoor spigot					$0.00
		Subtotal Cost	**$25**			
		TOTAL ADDED COST H.				**$0.00**
J.	**Lighting & Electrical**					
	Service	100 Amp, new breaker panel			Quantity	
	Lighting	Pin-based CFL fixtures (total of 13)	$300	total		$0.00
	Ceiling fans	LR, Kit, 2 BRs (4 at $75 each)	$300	total		$0.00
	Garbage disposal	none; compost system in place	-$75	total		$0.00
		Subtotal Cost	**$525**			
		TOTAL ADDED COST J.				**$0.00**
	SUMMARY OF MEDIUM GREEN PREMIUM					
		TOTALS OF ITEMS A. THRU J. ABOVE				**$325.00**
		Percentage of base case cost of			**1**	**32500%**
					Budget cost	(Percentage
					fill in	formula)

DEEP GREEN GBT MATRIX						
	ITEM	Deep Green Upgrade HERS 90	ADDED COST	UNIT	FILL IN AREA or quantity	TOTALS
		Finance added cost w/ EEM				
A.	**Exterior Walls**				Enter wall	
	Exterior Walls - Front / Rear at 1st & 2nd Floors				area here	
	Structure	Brick masonry, existing				$0.00
	New Int Framing	3-5/8" metal studs held 1" off brick	-$0.18	SF		$0.00
	Insulation	5" "AirKrete" (R-19)	$1.90	SF		$0.00
	Vapor retarder	None needed		SF		$0.00
	Interior sheathing	1/2" Recycled-content GWB	$0.10	SF		$0.00
		Subtotal Cost	**$1.82**	**SF**		**$0.00**
					Enter wall	
	Exterior Walls - Front & Rear Basement				area here	
	New Int Framing	none required (or buyer option?)				$0.00
	Insulation	R-19 foil face, draped full ht.	$0.68	SF		$0.00
	Vapor retarder	see above				$0.00
	Interior sheathing	none (buyer option: GWB finish)				$0.00
	Rear Exterior Finish	Fiber Cement Sid'g over 1/2" foam	$3.50	SF		$0.00
		Subtotal Cost	**$4.18**	**SF**		**$0.00**
		TOTAL ADDED COST A.				**$0.00**
B.	**Party Walls**				Enter wall	
	Side Walls (Party Walls) Assembly - 1st & 2cd floor				area here	
	Structure	Existing wall, crack control				$0.00
	Framing	1-5/8" mtl studs	$0.65	SF		$0.00
	Insulation	"Air-Krete" (R-5.5)	$0.83	SF		$0.00
	Interior sheathing	1/2" Recycled-content GWB	$0.10	SF		$0.00
		Subtotal Cost	**$1.58**	**SF**		**$0.00**
					Enter wall	
	Side Walls (Party walls) Assembly - Basement				area here	
	Structure	Brick masonry, existing				$0.00
	Int framing	Plastic lumber furring 2"				$0.00
	Insulation	2" "Air-Krete" (foamed behind screen)	$1.00	SF		$0.00
	Interior sheathing	none (buyer option: GWB finish)				$0.00
		Subtotal Cost	**$1.00**	**SF**		**$0.00**
		TOTAL ADDED COST B.				**$0.00**
C.	**Roof Assembly**				Roof area	
	Roof framing	Existing - assume 2 x 8			or quantity	
	Ceiling framing	None; cathedral ceiling	-$0.30	SF		$0.00
	Insulation	8" "Air-Krete" (R-31)	$4.00	SF		$0.00
	Vapor retarder	None (Note 3)				$0.00
	Sheathing	Certified OSB 3/4" over exist.	$0.82	SF		$0.00
	Roofing	Energy Star membrane	$5.00	SF		$0.00
	Roof ventilation	Turbine	$30.00	EA		$0.00
	Finish interior	1/2" Recycled-content GWB	$0.10	SF		$0.00
		Subtotal Cost	**$9.62**	**SF**		
		TOTAL ADDED COST C.				**$0.00**

Assemblies Matrix

D.	**Windows & Doors**				Enter quantity	
	Windows	Fiberglass low-E Argon fill	$100.00	EA		$0.00
	Front door	6-panel insul fiberglass	-$75.00	EA		$0.00
	Rear door	6-panel insul fiberglass	-$75.00	EA		$0.00
	Skylight	Solar tube plus new one in Bathroom	$250.00	EA		$0.00
		TOTAL ADDED COST D.				**$0.00**
E.	**Interior Assemblies**					
	Basement Floor				Area or amt.	
	Floor seal, insulation	New insulated slab and perim, Radon prevention measures	$1.00	SF		$0.00
	Radon test	Yes; seal as appropriate		EA		$0.00
	First Floor Assembly				Floor area	
	Joists	Existing wood			here	
	Insulation	3" cotton batts	$1.20	SF		$0.00
	Sub Floor / Deck	Existing T & G wood				$0.00
	Underlayment	Homosote 1.25" T&G	$2.20	SF		$0.00
	Finish Floor - LR, DR	Refinish existing strip wd.				$0.00
	Kitchen, Powder Rm	Recycled glass ceramic tile	$5.50	SF		$0.00
	(Optional LR, DR)	Area rugs on wood floor				$0.00
	Second Floor Assembly				Floor area	
	Joists				here	
	Finish Floor - Bath	Recycled glass ceramic tile	$5.50	SF		$0.00
	Other rooms	Area rugs on wood floor	-$1.40	SF		$0.00
	Interior Finish Materials				See units	
	Paint	Low VOC	$0.04	SF		$0.00
	Adhesives	Low- VOC		EA		$0.00
	Wall Tile	Recycled glass ceramic tile	$5.50	SF		$0.00
	Trim	Formaldehyde-free MDF	$0.40	LF		$0.00
	Counter tops	Recycled plastic board	$1.00	SF		$0.00
		TOTAL ADDED COST E.				**$0.00**
F.	**Appliances/Equip**				Quantity	
	Stove	Electronic ignition gas		EA		$0.00
	Refrigerator	Ultra-efficient (e.g., Eco-Fridge)	$700	EA		$0.00
	Microwave	Vented unit - double as range hood	$125	EA		$0.00
	Kitchen vent	See above	$0	EA		$0.00
	Dishwasher	Water, energy efficient		EA		$0.00
	Washing machine	Combo washer / dryer	$250	EA		$0.00
	Dryer	(e.g., Equator brand)	$0	EA		$0.00
	Cabinets	Solid certified wood		EA		$0.00
		Subtotal Cost	**$1,075**			
		TOTAL ADDED COST F.				**$0.00**

Assemblies Matrix

G.	**HVAC Systems**				Quantity	
	Heating	Forced air, solar HW combo unit	$450	EA		$0.00
	Cooling	SEER 15 condensor	$1,500	EA		$0.00
		1.5 Ton				$0.00
	Infiltration/Weather	ACH +/- 0.2 & mech ventilation	$350	EA		$0.00
	Ventilation	Provide timer on bath & Kit vents	$85	EA		$0.00
	Ducting	Duct leakage = 0	$175	EA		$0.00
	Water Heater (gas)	Demand (gas) backup to solar	$320	EA		$0.00
	Thermostat	Digital clock thermostat (2)	$150	EA		$0.00
	Fire Protection	Fully Sprinklered - option	$1,800	EA		$0.00
		Subtotal Cost	**$3,030**	**EA**		
		TOTAL ADDED COST G.				**$0.00**
H.	**Plumbing**				Quantity	
	Water Supply	City water: Particle, and Active Carbon canister filtration	$350	EA		$0.00
	Bathtub			EA		$0.00
	Shower	Water-saving head		EA		$0.00
	Sinks			EA		$0.00
	Toilet	Dual flush 0.8 / 1.6 GPF	$175	EA		$0.00
	Kitchen Sink			EA		$0.00
	Outdoor spigot	none; use rainwater catchment		EA		$0.00
		Subtotal Cost	**$525**			
		TOTAL ADDED COST H.				**$0.00**
J.	**Lighting & Electrical**				Quantity	
	Service	100 Amp, new breaker panel				$0.00
	Lighting	Pin-based CFL fixtures (total of 13)	$300	total		$0.00
	Ceiling fans	LR, Kit, 2 BRs (4 at $75 each)	$300	total		$0.00
	Garbage disposal	none; compost system in place	-$75	total		$0.00
		Subtotal Cost	**$525**			
		TOTAL ADDED COST J.				**$0.00**
	SUMMARY OF DEEP GREEN PREMIUM					
		TOTALS OF ITEMS A. THRU J. ABOVE				**$0.00**
		Percentage of base case cost of			**1**	**0%**
					Budget cost fill in	Percentage formula)

Section 5 Implementation Issues

Introduction

This Green Building Template includes background research and recommendations for three alternative "green" renovations. Implementation in the form of a demonstration project would include further analysis and testing of the house, as well as contractor education and training, and possibly a pilot project for construction and demolition waste recycling.

5A Full Energy and Indoor Air Quality Audit

At the start of the project, monitoring apparatus would acquiring data before and immediately after the renovations. This should include two temperature probes, a data logger, two Relative Humdity (RH) probes, a furnace blower elapsed time meter, a weather station (T, RH, Vw) , (alt.) a boiler firing event logging, a blower door test, measure of solar intensity, and a monthly site visit to get data and check thermostat settings.

5B Contractor Education and Training

Includes economic development opp's (Air Krete, Home Energy Raters etc)

5C Homeowner Training & User's Manual

Many for profit and non-profit developers working on providing innovative and green renovations are also developing "Homeowner Manuals". The manuals range from simple 2 to 3 page "fact sheets" to a more comprehensive, 3 ring binder similar to a Home Inspection document. The manuals are tailored to the demographics of the homeowners and often include worksheets for helping the homeowners track their energy use.

Southface Energy Institute has a particularly good manual called "Keeping Your Home Safe, Attractive and Affordable—A Home Owner's Manual" which is about 20 pages long. It is easily reproduced and covers three sections:

1) Emergencies
2) Energy Choices
3) Regular Maintenance

and an appendix called "More Information".
It is chock full of practical, easy to understand tips, information on why decisions were made and how to take care of all the major systems within the house. The manual also has simple illustrations accompanying most of the information. P

For the GBT, it is a bit premature to write a Home Owner's Manual, as the options selected will vary with the developer, home owner and contractor working on a specific renovation. However, it is highly recommended that a manual be developed for the next edition of the GBT. It can be a very useful tool to both the homeowner, builders and to the general public.

5D Financing Prospects & the Energy Efficient Mortgage (EEM)

Background

Energy efficiency remodeling as a key component of Green Modernization requires adopting an investment mentality - one spends money up front to make changes that produce significant long lasting positive cash flows. This new approach differs from simply "saving" (money) which implies great reluctance to take risks, much as the concept of "conservation" means cutting back or not using energy, as opposed to the concept of efficiency -- which connotes more intelligent usage of energy through innovation and technology.

Some people are satisfied with negative real returns; like taxable 2.0% bank accounts or money market funds when real inflation is running at 2.5% to 3.5%. After taxes (28% bracket) such a "savings plan" might represent a real net loss!

SECTION 5: Implementation Issues

When you invest in energy efficiency there are as of yet no taxes on the cash flow returns of not paying as high utility bills. However, since these returns are obtained in reductions on utility bills, they are not as immediately tangible as a stock dividend check, or an interest payment, for example.

Monthly utility bill savings matter most in a families overall cash flow and budget process. If you reduce an example $1200 annual utility bill by 30%, this yields $360 per year of essentially "new funds" available for other purposes. If someone made $25,000 last year, this would be like getting a 1.4% raise tax-free (or ~ 2.5 % tax adjusted). Looked at another way, the $30 per month savings would just about cover a basic phone bill, or perhaps a good portion of vehicle fuel costs for your commute. It might not seem like much but for less well off families however, a real reduction in monthly housing costs represented by low energy bills may make the difference between being a home owner or not!

Example of Simple Cash Flow from Investment:

- You get a return of $360 per year from the efficiency investment (added first cost of improvements)
- Investment generates mortgage principal increase of $2500 (30-year term);
- You make a 10 % down-payment ($250), with two origination points ($50);
- Loan generates approximate $14.00/month added mortgage charge ($168/year);
- Homeowner obtains positive cash flow early into second year ($468/$360 = 1.3).

Following this example, in the second quarter of the second year following the investment, the energy efficiency then effectively pays the homeowner just like a dividend check, except with no taxes. In the second year the earnings would top 3 percent net on the $2500 investment, despite paying off the first-year's balance of down-payment.

In the third -- and subsequent years -- the return would increase to about 7% to 8%. This rate of return could even improve if utility bills escalate faster than the rate of inflation and interest rates stay low. These other choices include: losing 2 percent or more on a bank's CD, taking a chance on a shaky stock market and being taxed on your earnings, or getting a significantly better return from investing in home energy efficiency.

We would all like to invest and get good returns, but to keep energy efficiency more affordable, what are some other avenues to get money up front, since the time horizon on this particular investment is long, and the earning not very liquid (no "check" each month from the bank)?

What is an Energy Efficiency Mortgage?

This section was derived directly from the descriptive materials provided by the National Residential Energy Services Network (RESNET) [http://www.natresnet.org]. RESNET provides a generic definition of an energy mortgage on its web site:

"...a mortgage that credits a home's energy efficiency in the home loan."

For an energy efficient (new) home, for example, it could mean allowing the borrower a greater debt-to-income ratio and giving the home buyer the ability to buy a higher quality home because of the lower monthly costs of heating and cooling the home. For homes in which the energy efficiency can be improved, this concept allows the money saved in monthly utility bills to finance energy improvements. A variety of energy mortgages have appeared in recent years and more are anticipated as RESNET, the operating home energy rating systems and the Environmental Protection Agency increase education/information outreach.

Energy mortgages come in two basic categories: energy efficient mortgages used to finance homes that are already energy efficient, and energy improvement mortgages used to improve the efficiency of existing homes. Both federally insured mortgages programs (Federal Housing Administration and Veterans Administration) may sponsor energy mortgages, as well as the conventional secondary mortgage market (Fannie Mae and Freddie Mac). As interest in improving the energy efficiency of America's housing stock increases, so has the availability of energy mortgages. A variety of approaches have been piloted in select states and several energy mortgage programs are now available nationwide. The two types of energy mortgages are:

Energy Efficiency Mortgages (EEM's) - (Initial Form)

In its initial form, the energy efficient mortgage was a straight two-percent "stretch" which allowed the buyers of energy efficient homes to qualify for up to two percent more overall debt when qualifying for a mortgage, because of their prospective lower monthly utility costs. This "stretch" allowed more buyers to afford higher quality energy-efficient homes. This program worked best when a home energy rating system is available to document the relative efficiency of a home. Fannie Mae also issued lending letters that described other qualification processes as well as on-site analysis or "energy performance ratings."

Other EEM approaches included innovative "deals" created by specific state programs. One state housing finance agency experimented with an interest rate reduction program which allowed the buyers of homes with home energy ratings exceeding the state's energy code to qualify for lower interest rates. Another state housing finance agency has offered down-payment assistance for the purchase of high energy-rated homes. Both programs were extremely successful in spurring consumer demand for energy efficient homes.

The U.S. Department of Housing and Urban Development's (HUD) Federal Housing Administration (FHA) announced in 1999 its new version of the energy efficient mortgage program. Basically, FHA will allow home buyers to finance the energy efficiency of a new home above its appraised value when the home energy rating documents the home exceeds the Model Energy Code. Through this program, home buyers can purchase homes whose prices somewhat exceeding the FHA limits.

Upgrades of Existing Homes -

This type of energy efficient mortgage finances cost-effective improvements recommended in an energy-rating through the mortgage at the time of sale or refinancing.

A home energy rater inspects the home and makes recommendations on cost-effective energy improvements. The rating also provides information on the relative economic return on the improvements. The funds for the improvements are placed into an escrow by the lending institution. The home owner has a minimum of three months after closing to make the improvements.

Once the improvements are made, a post-improvement home energy rating is performed to confirm the improvements were installed. The lending institution then releases the escrow funds to pay for materials and contracted labor. The total expended is rolled into the mortgage loan.

The FHA and VA mortgage energy improvement mortgage programs can finance energy improvements above the appraised value, if the measures are shown to be economical.

For a median home the EEM process puts an additional $2500 on the table to use boosting energy efficiency in single family housing. The remodelor / builder / community action agency should help consumers seek an EEM, which all the major secondary lenders like Fannie Mae and Freddie Mac, have accepted for some time.

Real effort is needed to provide proper and timely information the Bank, Savings and Loan or Mortgage Broker handling the deal to make sure the EEM goes through. EEM's can help qualify buyers for a more costly house, and hence can help offset first costs of added energy features, like better insulation and windows.

How an Energy Efficiency Mortgage Works

Here are two more detailed examples an energy efficient mortgage and an improvement mortgage. In the first, the home buyer adds $4,000 to his mortgage loan to finance the energy upgrade of the home being purchased. The increase in the monthly mortgage payments, resulting from the financing of the energy upgrades, is more than offset by the monthly energy savings. The second example illustrates how the stretch works so a buyer can afford a more expensive, energy efficient home.

EXAMPLE I: ENERGY IMPROVEMENT MORTGAGE

$75,000 VA 30-Year Mortgage at 7.5% Interest
(Source: Energy Rated Homes of Vermont, Inc.)

Monthly Costs	With $4,000 in energy improvements	Without energy improvements
Monthly mortgage payment	$552.38	$524.42
Monthly energy expenses	$90.00	$150.00
Total monthly cost	$642.38	$674.42

The buyer in this example reduces his monthly housing costs by $32 --- nearly $400 a year --- and has a more comfortable and durable home, after making the energy efficiency improvements.

EXAMPLE II: ENERGY EFFICIENT MORTGAGE

2% Stretch - Increased Debt-to-Income Ratio
When Buying an Energy Efficient Home
(Source: Energy Rated Homes of Alaska, Inc.)

Monthly Income	Regular Mortgage	Energy Efficient Mortgage	Increased Purchase Power
$2,000	$62,500	$66,933	$4,433
$2,250	$70,223	$75,372	$5,149
$2,750	$83,667	$85,955	$5,578
$3,000	$93,678	$100,400	$6,722

Buyer of an Energy Efficient Home Can Get a Bigger Mortgage Loan and More Easily Afford A Home!

The institutionalization of energy mortgages into the national mortgage market and their widespread use could mean a significant improvement in the quality of our country's housing stock without a great infusion of government or utility funds.

Energy improvement mortgages offer home buyers of existing homes opportunities to:

- Upgrade homes immediately without tapping the family's savings or taking out a higher interest, home improvement loan.
- Own a more comfortable home that costs less to heat and cool.
- Net a better return when selling because of the higher resale value.

Energy efficient mortgages offer opportunities to:

- Help less affluent American families achieve the dream of home ownership.
- Purchase higher quality and more affordable housing.
- Create a market demand and value for energy efficient homes.
- Improve new construction standards above minimum energy codes.

(This section is based on a presentation on Energy Efficiency Mortgage (EEM) information provided on line, by the National Residential Energy Services Network.)

5E One-Year Post Occupancy Evaluation

The one-year post-occupancy evaluation should include a final blower door test, a final as-built condition assessment, a performance report on the 12-month data records, and a re-run of computer predictions (HERS check) using site weather records. Reporting could be set up to be done on a monthly basis, or to perform a thorough assessment at the one-year anniversary of occupancy.

A minimal approach would be to just compare billing data before and after renovations, but this would not include temperatures, RH, or specific measures effectiveness. However, overall energy use reductions could be estimated. Note that this approach would not work for major rehab if subject building was an unoccupied shell prior to applying the template to its refurbishment.

APPENDIX A.1: Meeting Notes & Project Directory

Organization	Contact	Telecom
Building Environmental Science & Technology P.O. Box 1107 Edgewater, MD 21037	**Bion Howard** President	Ph: (W) +1(410) 867-8000 Ph: (C) Fax: (301) 889-0889 Email: bdhoward@ix.netcom.com
Clearinghouse for Healthy Communities 1100 N. Rutland Street Baltimore, MD 21213	**Michelle Brown** Director	Ph: (W) (410) 327-0048 Ph: (C) Fax: Email: cchc1@hotmail.com
Education, Bay Policy, and Growth Management Services, Department of Natural Resources Tawes State Office Building, E-2 Annapolis, MD 21401	**Mr. Mark Bundy** Director	Ph: (W) (410) 260-8720 Ph: (C) (410) 570-7120 Fax: Email: mbundy@dnr.state.md.us
Julie E. Gabrielli, AIA Architect 5600 Pimlico Road Baltimore, MD 21209-4336	**Ms. Julie Gabrielli**	Ph: (W) (410) 542-0747 Ph: (C) Fax: (410) 542-3516 Email: gabrielli@toad.net
Kim Schaefer Architects 927 So. Walter Reed Dr. Arlington, VA 22204	**Ms. Kim Schaefer AIA** Principal	Ph: (W) (703) 521-8158 Ph: (C) (703) 303-6560 Fax: (703) 521-8133 Email: ecoarch@erols.com
Middle East CDC 1100 N. Rutland Street Baltimore, MD 21213	**Ms. Lucille Gorham** Director	Ph: (W) (410) 522-2574 Ph: (C) Fax: Email:
Middle East CDC Residential Bldg Improvement Co. 400 East Pratt St Baltimore, MD 21202	**Mr. Don Norwood** Manager	Ph: (W) (410) 493-7562 Ph: (C) Fax: (775) 307-1322 Email: bric21202@email.com
Patterson Park Community Development Corporation 2900 East Baltimore St Baltimore, MD 21224	**Mr. James Shetler** Deputy Director	Ph: (W) (410) 732-1609 Ph: (C) Fax: (410) 563-9386 Email: jimmyg@ppcdc.org
Patterson Park Community Development Corporation 2900 East Baltimore St Baltimore, MD 21224	**Ms. Heather Stauffer** Architect Intern	Ph: (W) (410) 732-1609 Ph: (C) Fax: (410) 563-9386 Email: heather@ppcdc.org
Southway Builders, Inc. 1318 East Fort Ave Baltimore, MD 21230	**Mr. Timothy Duke**	Ph: (W) (410) 332-4134 Fax: (410) 332-4136 Email: tim@southwaybuilders.com

APPENDIX A.1: Meeting Notes & Project Directory

Maryland Energy Administration 1623 Forest Drive, Suite 300 Annapolis, MD 21403	**Mr. W. Dale Baxter** Assistant Director	Ph: (W) (410) 260-7655 Ph: (C) Fax: (410) 974-2250 Email: dbaxter@energy.state.md.us
Maryland Energy Administration 1623 Forest Drive, Suite 300 Annapolis, MD 21403	**Mr. Charles Miller** Manager, Renewable Energy Programs	Ph: (W) (410) 260-7190 Ph: (C) Fax: (410) 974-2250 / 2875 Email: cmiller@energy.state.md.us
Department of Natural Resources Tawes State Office Building, E-2 Annapolis, MD 21401	**Mr. Mike Li** Policy Fellow	Ph: (W) (410) 260-8797 Ph: (C) Fax: Email: mli@dnr.state.md.us

The following items are the written Meeting Notes for our two official meetings. We had a third follow up meeting of which there are no notes.

Green Building Template for Urban Rowhouse Redevelopment
Meeting Minutes 8.2.01

Location: Southway Builders 1:00 p.m. to 4:00 p.m.

Attendees: Heather Stauffer, PP-CDC; Lucille Gorham, ME-CDC; Michelle Brown, ME-CDC; Don Norwood, ME-CDC; Dale Baxter, MEA; Charles Miller, MEA; Mike Li, DNR; Mark Bundy, DNR; Tim Duke, Southway; Kim Schaefer; Julie Gabrielli

Meeting Notes

1. What is "green"?

1-a Focus on energy efficiency and healthy indoor environment., which most benefit the homeowner.

1-b Do statistics exist for this housing type to track energy costs related to household expenses or as a proportion of income? DOE surveys of residential consumption for our area are too broad and general to be useful. This would make a great companion project for a University statistics class. For this project, yearly energy bills could be analyzed, perhaps using $ per square foot as a comparison. PP-CDC and ME-CDC will look into gathering bills from their neighbors.

1-c Marketing materials for home renovations could state typical yearly energy costs for standard renovation in comparison to more energy-efficient green renovated houses, thereby highlighting the savings.

1-d Charles Miller mentioned an article reprint from "Environmental Building News," entitled, "What is Green?" He will forward a copy to Julie for distribution.

1-e A one-page summary green building benefits was distributed.

2. Project goals – five overall goals were discussed

2-a *Energy efficient.* Strategies include good thermal protection; reduced air leakage; high efficiency mechanical systems; climatic design (orientation, breezes); high efficiency appliances & lighting; and use of renewables such as solar hot water assist or photovoltaic cells.

Three levels are currently proposed: "Good" (light green) at least as energy efficient as new home built to MD code at HERS 80; "Better" (medium green) at HERS 86 "EnergyStar" level; and "Best" (deep green) at HERS 90+ . A key goal is to increase affordability for first-time buyers by tapping into the Energy Efficient Mortgage (EEM), which would require the HERS 86 or better rating. Thus, the light green version may not be worth the extra costs involved. See section 4 below for more detailed discussion of these alternatives.

Mark mentioned that a few Baltimore-area banks have been identified as potential partners for the EEM on the demonstration version of the Template.

One easy place to save energy is with domestic hot water heaters, which are typically set at much too high a temperature. Demand water heaters are also being considered for the Template alternatives.

2-b *Create healthy indoor environment.* Strategies include: control moisture; ventilation (natural that works or mechanical); careful material selection – low VOC offgassing, no formaldehyde glues or resins; and testing for radon gas. Lead is an important consideration in these houses. ME-CDC typically abates all the lead-containing materials in a rehab project. Kim asked for information from them. The water line from the street to the house was also originally of lead content. Tim Duke mentioned that the city is obligated to change this supply line if identified during the renovation project. There was some uncertainty about their policy, so we will check into this. Mike Li mentioned that DHCD is revising their lead policy, and has a contact to pass on.

2-c *Reduce resource consumption.* Strategies include material selection (avoid PVC, use local, recycled or salvaged / reclaimed or renewable); use water-saving fixtures; set up a C & D waste recycling program and on-site composting system in lieu of kitchen sink disposals. Tim noted that typically during a gut rehab, all the demo items get piled together, thereby "diluting" the lead concentration of the whole. Separating

different materials for recycling might present a disposal problem for the contractor. Kim asked what quantities of refuse are generated during demo, typically. Recycling during construction is the second half of the equation and requires a set program and subcontractor training.

2-d *Easy to operate and maintain*. Strategies include material selection (durable, with low or no maintenance); programmable thermostat; and homeowner guidelines / education programs. Mark emphasized sensitivity in selection of thermostats that are easy to understand and use. If they are too intimidating or too easily overridden, projected energy savings may not materialize. It was noted that the PP-CDC typical thermostat is not programmable.

2-e *Site and community issues.* These include mitigating the urban heat island effect with light roof color, planting trees, and reducing impervious (paved) outdoor surfaces. Both CDC's are already working towards job creation in the construction trades, which could be extended into weatherization / home energy rating as this project progresses. There is also opportunity for developing a construction waste recycling program serving the neighborhood and beyond.

Greening is very appealing for many reasons, but can be at odds with homeowner needs. A backyard garden requires upkeep, while a paved area needs very little. Street trees add a tremendous amount of ambiance, not to mention value, to a block. Tree-lined streets are more inviting, and cooler, than those with no trees. It is important to understand why trees were removed historically, as well as to identify species that are compatible with an urban environment.

As there is a two to three year wait for the city to plant trees, some neighborhoods have started their own nursery and planting programs. A great example is the Hollins Street tree nursery at 1224 Hollins (corner of Hollins and Carey Streets) in Southwest Baltimore. Gary Letteron has been involved with that for several years. His contact information is 410-625-1751, email glue39@bcpl.net. Parks and People Foundation is also very active with community gardening throughout the city. Contact Guy Hager at 410-396-0198.

Cultural expectations – what's "normal" for a community – were discussed. Certain expectations may be at odds with some of the environmental goals – for example, the perception that vinyl windows are a superior "space-age" product. Developers often know their market best, and that sort of feedback is important to developing a usable Template.

3. Analysis of standard base case renovation

3-a A draft report was distributed that includes observations and analysis of the existing rowhouse and the typical renovation approach. Kim Schaefer asked attendees to review the report and respond with comments, corrections, questions within two weeks.

4. Shades of green alternatives – cost, feasibility

4-a Light green – target 0% to 2% added cost. Concern was raised about this alternative because its HERS rating is only projected to be about 80, which would not qualify for an Energy Efficient Mortgage (EEM). Therefore, added construction costs would be passed directly to the buyer. However, lower energy bills would potentially offset the higher mortgage payment. Charles asked whether this option could look at trading off higher insulation levels and tighter construction (cost adds) with a downsized HVAC system (cost savings), thus resulting in a "zero sum." The focus could be on creative solutions, perhaps eliminating central A/C in favor of ceiling fans, a whole-house fan, and/or one through-wall unit to cut humidity. Whole-house fans present some challenges: air quality from basement is questionable; if windows are opened on first floor to draw air upwards, security may be a concern, as well as environmental lead being drawn from outside through the house.

4-b Medium green – target 2% to 5% added cost. Financing the additional cost is a critical issue. Mark explained that CDC's get their funding in the form of block grants. So, there is a set amount of money to do a set number of projects. If a project's cost increases, then they can only do fewer projects, since the pot of money does not change. This is different from a for-profit developer, who can pass on added costs to the homeowner, who in turn gets an EEM to absorb them. Some CDC's, including Patterson Park, have begun borrowing money themselves as bridge financing for these sorts of upgrades. In that case, a higher cost is not such a burden. However, it is important for the Template to include an option that does not increase the first cost., as not all CDC's are willing or able to shop for additional financing.

4-c Deep green – target 7% to 10% added cost. This alternative was not discussed at this meeting. There is possibly a "diminishing return" for projects of this scale, as energy costs and other environmental impacts can only be reduced by so much. Still, this alternative might be used by a CDC as a "deluxe" upgrade for particularly interested homebuyers.

4-d Mark Bundy clarified an approach to these scenarios:
1. What is the best efficiency that can be achieved *with no additional cost*? (Understanding that it may not qualify for an EEM.) The light green alternative could address this.
2. What is the *minimum* that has to be spent in order to get a rating that *does* qualify for the EEM? The medium green alternative could address this.

4-e Don raised the question of how to measure or quantify the "healthiness" aspects, just as energy efficiency is being quantified. The list of benefits of green (distributed at this meeting) mentions a $500 per year savings per person with better indoor air quality. We will clarify the source of this statistic. Michelle mentioned that Hopkins is doing a study on the dollar value of healthy houses, with the Baltimore Neighborhood Indicators Alliance (BNIA). Don went to a meeting recently and has contacts. Their website if www.bnia.org. Mark mentioned that DNR is pursuing funding to do an American Lung Association Healthy House for affordable housing.

Questions and Follow-up Actions

1-b	(PP-CDC and ME-CDC)	Energy bills from neighbors for analysis
1-d	(Charles Miller)	"What is Green?" article from EBN – forward copy to Julie Gabrielli
2-a	(Mark Bundy)	Info on Baltimore-area banks as possible EEM partners for demo house
2-a	(Bion)	Water heater settings – can this be modeled in the energy analysis?
2-b	(Mark Bundy)	Who at MDE knows about radon and other soil gases in Baltimore city?
2-b	(ME-CDC)	Lead abatement scope of work and cost estimate for typical rowhouse rehab
2-b	(Tim Duke)	Who at City Water Dept. to ask about replacement of lead water supply lines
2-b	(Mike Li)	Contact at DHCD re: lead policy revisions
2-c	(Kim S or Julie G)	What are guidelines for disposal of lead-containing building materials? What is the likelihood of separating demo materials for recycling given lead-content of some?
2-c	(PP-CDC and ME-CDC)	Info on quantities of demo materials generated during renovation
2-d	(Bion Howard)	Thermostat selection criteria, choices, etc.
3-a	(All)	Review draft report and respond with comments
4-a	(Julie, Kim, Bion, Tim)	Rethink light green option as a no-cost alternative. Is whole-house fan a feasible alternative?
4-b	(Julie)	Verify with PP-CDC that they have ways to finance added first costs
4-d	(Julie, Kim, Bion, Tim)	Refine light green and medium green options to address cost concerns
4-e	(Bion)	Source of $500 / yr savings per person for good IAQ statistic
4-e	(Don, Michelle)	Contact from BNIA study on value of healthy houses

Green Building Template for Urban Rowhouse Redevelopment
Meeting Minutes 9.18.01

Location: Southway Builders 2:30 p.m. to 4:30 p.m.

Attendees: Heather Stauffer, PP-CDC; Lucille Gorham, ME-CDC; Michelle Brown, ME-CDC; Don Norwood, ME-CDC; David Brosch, Housing Authority of Baltimore (HABC); Charles Miller, MEA; Mike Li, DNR; Mark Bundy, DNR; Tim Duke, Southway; Kim Schaefer; Julie Gabrielli; Bion Howard

1. Review green alternates summary charts

Specific materials comments:

1-a White roof coating – Home Depot carries it; most likely no additional cost to typical tar recoat
Baltimore City standard is silver paint – similar reflectivity? We will research – question on content of paint, may be an environmental hazard
Recoat is typically every 3 years w/ tar or silver paint. If the white acrylic really is 10 years, that is a great difference.

1-b Cellulose – PP-CDC would prefer "stabilized", which sticks in place in open construction (when finishes are not done yet). Attic either install drywall first, leaving gaps to blow in cellulose, or use kraft paper or netting to hold it as it is sprayed.

1-c Adhesives – will recommend low VOCs. Careful to inspect when these are on the jobsite to verify they are as specified, and as recommended by the flooring manufacturer.

1-d Carpeting – PP-CDC typically does tack-down installation. Bion warned against direct-glue carpet on concrete, which is a classic place for hazardous molds to accumulate. (Michelle pointed out that carpeting in general is not recommended for healthy indoor air quality.)

1-e Consider walk-off mats, perhaps "built-in," to intercept outdoor dirt at the entryways.

1-f Steel doors are not acceptable to PP-CDC – they dent, and there may be historic district issues. Since they add insulation value, an alternative such as insulated fiberglass panel doors will be researched. A storm door on a wood panel door would add only R-1.2, as compared with the steel door at R-4 or R-5.

1-g Fluorescent lights raise concern – is the quality of the light (color) acceptable to residents? The replacement bulbs (that fit into an Edison socket) are less ideal, because they are expensive and will likely be replaced with incandescent. Fixtures designed for compact fluorescent lamps (CFLs) are available; the team will research and find some good alternates. Color rendering quality will also be researched.

Details notes:

1-h Attic / roof – important to seal all penetrations and around the perimeter to prevent air leaks, which can lead to moisture condensing in attic insulation and finish materials. This is especially possible in summer.

1-i Roof ventilation – either reopen cornice vents or install turbine vents. If rigid insulation is used above the roof deck, ventilation is not as critical.

1-j Another technology that HABC has tried recently is a urethene spray foam on top of the existing roofing. This acts as both an insulator and a strengthener, and a white acrylic coating is applied over it to protect it from the UV rays of the sun. This has a 10-year warranty. He invited those present to tour the house.

Cost notes:

1-k PP-CDC typically pays $3.00 / SF for vinyl flooring, installed. Ceramic tile is about $7.00 ($2.00 materials, $5.00 labor).

1-l The team will look at whether it would be helpful to include unit costs on the "base case" assemblies as well, to illustrate our assumptions. These costs are currently based on either the PP-CDC budget or on construction industry standards.

2. Energy calculations

2-a Service charges are currently the same for every household – about $120 / year just to have the hookup. Next legislative session will look at proposals to pro rate these charges based on either household income, energy use, or some combination.

2-b Reference: "Energy Design Update," March 2001 has article about green bundle hot water heating, which uses combo solar and demand-type hot water heater instead of a furnace. This option is proposed for the deep green alternate.

2-c The heating energy use is most affected by insulation levels and window quality; the cooling energy use is most affected by use of high-efficiency units; and the hot water heating is most affected by use of a demand-type unit instead of the typical hot water tank. Solar hot water preheat further reduces the hot water energy use to almost nothing.

2-d Energy Efficient Mortgage (EEM) – Maryland Energy Administration has a person working on this full-time, talking with lenders and others. There is potential for help with stretch ratio, closing costs, and lower interest rates.

2-e Cost / benefit does not look at simple "payback" on investment using yearly energy savings. Energy Star has a calculation that uses the energy modeling to look at the time value of money vis. lower interest rates and other mortgage benefits. As part of the Template, we will look at whether the homeowner would have a positive cash flow – i.e., whether their energy savings will match or exceed any additional mortgage payments to cover additional up-front costs.

2-f Ways for CDCs to finance additional up-front costs – a) do one less house to spread the cost around; or b) ask for additional money from the state up front, using the Template analysis to justify.

3. Report content outline

3-a Job training opportunities include weatherization. When done previously in the city, it was funded w/ Federal money, which is no longer available. The programs typically did not extend beyond the core area where they were started.

3-b Under Implementation Issues, which is the priority – contractor education or homeowner training? While both are important, the contractors need to be trained first, to assure a quality job that meets expectations. Bion noted that homeowner training can be done by a trained CDC staff, in an informal setting. A Homeowner's Manual would include "why your house is different" sections on where to call w/ problems and tips on how to be more earth-friendly in maintenance and yard / garden care. Southface Energy in Atlanta

has an excellent, very simple pamphlet that may be a good model. Charles suggested a study that looks at differences in houses built with trained crews versus those that are not.

3-c Follow-up studies are critical to look at long-term payoffs for energy improvements and other greening. Post-occupancy evaluations after one year of occupancy would yield a better understanding of resident behavior as well as to verify whether modeling assumptions were accurate.

3-d The team will look at a way to distinguish on the alternates worksheets those items that are "non-negotiable" (the energy-efficiency upgrades) from those items that utilize recycled materials or other earth-friendly strategies. While the latter are important, and are part of the reason for the Template, it is understood that energy efficiency is Job One here.

4. Next steps

4-a The State may look to require their money to be used to build "green," so the Template will likely undergo further testing and revisions in the coming years.

4-b Final draft will go out to everyone for review by 22 October. A final meeting to discuss and review the draft will take place on 6 November at 2:00.

APPENDIX A.2: Sample Copy of Energy Analysis Data

Over seventy analytical runs were made for the Green Building Template test case house. We have included one as a sample copy to demonstrate process and data collected and analyzed. A full set of copies of each "run" is available upon request for a fee of $35.00, to cover copying and delivery for the 50 page + set.

Utility Bills for Base Case Renovations - Patterson Park CDC

4 S. Curley St.

	Month and Year											
Energy Usage & Cost	Jan-00	Feb-00	Mar-00	Apr-00	May-00	Jun-00	Jul-00	Aug-00	Sep-00	Oct-00	Nov-00	Dec-00
kWh	232	233	274	277	1299	1296	1105	968	658	395	580	369
Electric amount	$24.42	$24.50	$28.02	$28.28	$130.10	$129.82	$102.48	$90.75	$53.60	$35.32	$48.18	$33.53
$ / kWh	$0.11	$0.11	$0.10	$0.10	$0.10	$0.10	$0.09	$0.09	$0.08	$0.09	$0.08	$0.09
Avg. annual cost / kWh	N/A	N/A	$0.0428	$0.0428	$0.0428	$0.0428	$0.0428	$0.0428	$0.0428	$0.0428	$0.0428	$0.0428
Therms	100	71	21	19	12	10	8	6	10	16	52	79
Gas amount	$75.66	$54.83	$25.10	$25.16	$19.59	$20.52	$19.27	$17.29	$21.30	$27.61	$55.87	$82.93
$ / therm	$0.76	$0.77	$1.20	$1.32	$1.63	$2.05	$2.41	$2.88	$2.13	$1.73	$1.07	$1.05
Avg. temperature (F)	41	29	40	50	53	66	73	73	73	64	56	43
Total bill - gas & elec	$100.08	$79.33	$53.12	$53.44	$149.69	$150.34	$121.75	$108.04	$74.90	$62.93	$104.05	$116.46

Total for year	
Jan 00 thru Dec 00	$1,174.13
Average monthly bill	$97.84

Adj annual usage	
kWh	7,686
therms	404

Actual annual usage	Jan 00 thru Dec 00
kWh	7,686
therms	404

Average monthly usage	Jan 00 thru Dec 00
kWh	641
therms	34

Utility Bills for Base Case Renovations - Patterson Park CDC

2 S. Curley St.

	Month and Year											
Energy Usage & Cost	Jan-00	Feb-00	Mar-00	Apr-00	May-00	Jun-00	Jul-00	Aug-00	Sep-00	Oct-00	Nov-00	Dec-00
kWh	97	77	42	85	58	21	40	63	86	97	142	48
Electric amount	$12.83	$11.12	$8.10	$11.80	$10.11	$6.54	$11.32	$13.30	$13.87	$14.64	$17.77	$11.24
$ / kWh	$0.13	$0.14	$0.19	$0.14	$0.17	$0.31	$0.28	$0.21	$0.16	$0.15	$0.13	$0.23
Avg. annual cost / kWh	N/A	N/A	$0.0428	$0.0428	$0.0428	$0.0428	$0.0428	$0.0428	$0.0428	$0.0428	$0.0428	$0.0428
Therms	89	61	24	27	17	16	15	15	15	17	44	43
Gas amount	$68.65	$48.80	$26.96	$30.70	$22.75	$25.47	$25.40	$24.83	$25.87	$28.60	$49.18	$50.71
$ / therm	$0.77	$0.80	$1.12	$1.14	$1.34	$1.59	$1.69	$1.66	$1.72	$1.68	$1.12	$1.18
Avg. temperature (F)	41	29	40	50	53	66	73	73	73	64	56	43
Total bill - gas & elec	$81.48	$59.92	$35.06	$42.50	$32.86	$32.01	$36.72	$38.13	$39.74	$43.24	$66.95	$61.95

Total for year	
Jan 00 thru Dec 00	$570.56
Average monthly bill	$47.55

Adj annual usage	
kWh	856
therms	383

Actual annual usage	Jan 00 thru Dec 00
kWh	856
therms	383

Average monthly usage	Jan 00 thru Dec 00
kWh	71
therms	32

Utility Bills for Base Case Renovations - Patterson Park CDC

34 N. Linwood Ave.

	Month and Year														
Energy Usage & Cost	Apr-00	May-00	Jun-00	Jul-00	Aug-00	Sep-00	Oct-00	Nov-00	Dec-00	Jan-01	Feb-01	Mar-01	Apr-01	May-01	Jun-01
kWh	108	267	1553	1011	803	707	326	224	296	338	282	241	469	1009	1556
Electric amount	$13.66	$30.32	$154.67	$94.43	$76.64	$57.01	$30.54	$23.46	$28.45	$31.38	$27.48	$24.64	$40.48	$96.11	$143.92
$ / kWh	$0.13	$0.11	$0.10	$0.09	$0.10	$0.08	$0.09	$0.10	$0.10	$0.09	$0.10	$0.10	$0.09	$0.10	$0.09
Avg. annual cost / kWh	$0.0428	$0.0428	$0.0428	$0.0428	$0.0428	$0.0428	$0.0428	$0.0428	$0.0428	$0.0428	$0.0428	$0.0428	$0.0428	$0.0439	$0.0439
Therms	6	8	9	7	6	8	11	20	44	27	21	11	9	9	8
Gas amount	$16.26	$17.02	$19.71	$18.33	$17.29	$19.51	$22.67	$29.11	$51.59	$39.03	$37.49	$22.11	$20.01	$19.27	18.13
$ / therm	$2.71	$2.13	$2.19	$2.62	$2.88	$2.44	$2.06	$1.46	$1.17	$1.45	$1.79	$2.01	$2.22	$2.14	$2.27
Avg. temperature (F)	50	54	66	73	73	73	64	56	55	29	34	39	42	57	64
Total bill - gas & elec	$29.92	$47.34	$174.38	$112.76	$93.93	$76.52	$53.21	$52.57	$80.04	$70.41	$64.97	$46.75	$60.49	$115.38	$162.05

Total for year		Total for year	
May 00 thru Apr 01	$933.37	July 00 thru June 01	$989.08
Average monthly bill	$77.78	Average monthly bill	$82.42

Adj annual usage	
kWh	7,500
therms	183

Actual annual usage	May 00 thru Apr 01	July 00 thru June 01
kWh	6,625	7,262
therms	187	181

Average monthly usage	May 00 thru Apr 01	July 00 thru June 01
kWh	552	605
therms	16	15

APPENDIX A.3: Energy and Water Bills Data

The following spreadsheets are the summary of the energy bills and water bills we received for the following properties:

From Patterson Park CDC – Annual utilities for 34 N. Linwood

From Middle East CDC – Annual energy bills for 2 and 4 S. Curley

APPENDIX A.4: Back-up Cost Information for Matrices

The following pages contain two samples of filled in matrices for the Lite and Medium Green Templates. The Deep Green version contains the most innovative strategies and is the most customized of the options presented. At this time, it is hard to estimate solar hw or PV systems, super environmentally friendly materials and other items as well as experience of the contractor with these types of installations. If a homeowner or CDC opts for a Deep Green Strategy, then we would recommend that they use the form for their cost estimate based on actual bid prices.

GREEN BUILDING TEMPLATE -WORKSHEET						
		Meets MEC 92 for new home			FILL IN	
	ITEM	Light Green Upgrade	ADDED	UNIT	AREA	TOTALS
		HERS 80	COST		or quantity	
		Qualifies for Energy Star Home				
A.	**Exterior Walls**				Enter wall	
	Exterior Walls - Front / Rear at 1st & 2nd Floors				area here	
	Structure	Brick masonry, existing				$0.00
	New Int Framing	2 x 4 certif wood at 16" o.c.	$0.00	SF		$0.00
	Insulation	R-11 Cellulose blown-in	$0.20	SF	420	$84.00
	Vapor retarder	VR paint on interior	$0.07	SF	420	$29.40
	Interior sheathing	1/2" GWB				$0.00
		Subtotal Cost	**$0.27**	**SF**		**$113.40**
					Enter wall	
	Exterior Walls - Front & Rear Basement				area here	
	New Int Framing	None				$0.00
	Insulation	Min R-11 foil face drape 1/2 wall	$0.54	SF	80	$43.20
	Vapor retarder	see above				$0.00
	Interior sheathing	no				$0.00
	Rear Exterior Finish	Brick existing				$0.00
		Subtotal Cost	**$0.54**	**SF**		**$43.20**
		TOTAL ADDED COST A.				**$156.60**
B.	**Party Walls**				Enter wall	
	Side Walls (Party Walls) Assembly - 1st & 2cd floor				area here	
	Structure	Exist'g brick - 8" thk (4" to PL)				$0.00
	Framing	Repair existing furring				$0.00
	Insulation	none, except near corners	$0.36	SF	80	$28.80
	Interior sheathing	1/2" GWB				$0.00
		Subtotal Cost	**$0.36**	**SF**		**$28.80**
					Enter wall	
	Side Walls (Party walls) Assembly - Basement				area here	
	Structure	Brick masonry, existing				$0.00
	Int framing	none				$0.00
	Insulation	none	$0			$0.00
	Interior sheathing	no				$0.00
		Subtotal Cost	**$0.00**	**SF**		**$0.00**
		TOTAL ADDED COST B.				**$28.80**
C.	**Roof Assembly**				Roof area	
	Roof framing	Existing - assume 2 x 8			or quantity	
	Ceiling framing	2 x 6 wood				$0.00
	Insulation	R-24 loose blown cellulose	$0.16	SF	600	$96.00
	Vapor retarder	Seal joints, VR paint interior	$0.04	SF	600	$24.00
	Sheathing	OSB 5/8" over exist.	$0.71	SF	600	$426.00
	Roofing	B.U.R.- white acrylic coating	$0.10	SF	600	$60.00
	Roof ventilation	Goose neck	$30.00	EA	2	$60.00
	Finish interior	1/2" GWB				$0.00
		Subtotal Cost	**$1.01**	**SF**		
		TOTAL ADDED COST C.				**$666.00**

Assemblies Matrix

D.	**Windows & Doors**				Enter quantity	
	Windows	Vinyl low-E insulated glass	$24.00	EA	8	$192.00
	Front door	Insul. Steel (R-4)	-$185.00	EA	1	-$185.00
	Rear door	Insul. Steel (R-4) w/ lites?	-$185.00	EA	1	-$185.00
	Skylight	Retrofit Double glazing	$80.00	EA	1	$80.00
		TOTAL ADDED COST D.				**-$98.00**
E.	**Interior Assemblies**					
	Basement Floor				Area or amt.	
	Floor seal, insulation	Exist'g conc, sealed		SF		$0.00
	Radon test	Yes; seal as appropriate		EA		$0.00
	First Floor Assembly				Floor area	
	Joists	Existing wood			here	
	Insulation	none				
	Sub Floor / Deck	Existing T & G wood		SF		$0.00
	Underlayment	Masonite		SF		$0.00
	Finish Floor - LR, DR	Refinish existing strip wd.		SF		$0.00
	Kitchen, Powder Rm	Linoleum Kitchen & Powder Rm	$2.20	SF	160	$352.00
	(Optional LR, DR)	Recycled PET Berber carpet		SF		$0.00
	Second Floor Assembly				Floor area	
	Joists	Existing			here	
	Finish Floor - Bath	Linoleum	$2.20	SF	25	$55.00
	Other rooms	Recycled PET Berber carpet		SF		$0.00
	Interior Finish Materials				See units	
	Paint	Low- VOC	$0.04	SF	7500	$300.00
	Adhesives	Low- VOC		EA		$0.00
	Wall Tile	Reclaimed ceramic tile		SF		$0.00
	Trim	Finger-jointed wood?		LF		$0.00
	Counter tops	"Firecrete" cementitious bd.		SF		$0.00
		TOTAL ADDED COST E.				**$707.00**
F.	**Appliances/Equip**				Quantity	
	Stove	Standard		EA		$0.00
	Refrigerator	Energy Star, 18 CF	$0	EA		$0.00
	Microwave	by owner?		EA		$0.00
	Kitchen vent	Outside venting, 2-speed hood	$75	EA	1	$75.00
	Dishwasher	Standard		EA		$0.00
	Washing machine	Standard		EA		$0.00
	Dryer	Standard		EA		$0.00
	Cabinets	Wheatboard?		EA		$0.00
		Subtotal Cost	**$75**			
		TOTAL ADDED COST F.				**$75.00**

Assemblies Matrix

G.	**HVAC Systems**				Quantity	
	Heating	Forced Air, Gas 84 AFUE				$0.00
	Cooling	SEER 11 Condenser	$0			$0.00
		2 ton				$0.00
	Infiltration/Weather	routine weatherization				$0.00
	Ventilation	Same as base case	$0	EA		$0.00
	Ducting	Duct leakage < or = 10%	$175	EA	1	$175.00
	Water Heater (gas)	Upgrade efficiency	$125	EA	1	$125.00
	Thermostat	Digital clock thermostat	$75	EA	1	$75.00
	Fire Protection	None required; hardwired smoke detectors				$0.00
		Subtotal Cost	**$375**	**EA**		
		TOTAL ADDED COST G.				**$375.00**
H.	**Plumbing**					
	Water Supply	City			Quantity	
	Bathtub			EA		$0.00
	Shower	Water-saving head		EA		$0.00
	Sinks			EA		$0.00
	Toilet	1.6 G/F unit		EA		$0.00
	Kitchen Sink			EA		$0.00
	Outdoor spigot			EA		$0.00
		Subtotal Cost	**$0**			
		TOTAL ADDED COST H.				**$0.00**
J.	**Lighting & Electrical**					
	Service	100 Amp, new breaker panel			Quantity	
	Lighting	Fluorescent bulbs in std fixtures	$100	total	1	$100.00
	Ceiling fans	LR, DR, Kitchen (3 at $75 each)	$225	total	1	$225.00
	Garbage disposal	Same as base case				$0.00
		Subtotal Cost	**$325**			
		TOTAL ADDED COST J.				**$325.00**
	SUMMARY OF LIGHT GREEN PREMIUM					
		TOTALS OF ITEMS A. THRU J. ABOVE				**$2,235.40**
		Percentage of base case cost of			**$48,395**	**4.62%**
					Budget cost	(Percentage

GREEN BUILDING TEMPLATE - WORKSHEET						
	ITEM	Medium Green Upgrade HERS ~86	ADDED COST	UNIT	FILL IN AREA or quantity	TOTALS
		Qualifies for Energy Star Home				
A.	**Exterior Walls**				Enter wall	
	Exterior Walls - Front / Rear at 1st & 2nd Floors				area here	
	Structure	Brick masonry, existing				$0.00
	New Int Framing	1-5/8" metal studs held 3" off brick	-$0.38	SF	420	-$159.60
	Insulation	R-19 Stabilized cellulose filled	$0.60	SF	420	$252.00
	Vapor retarder	VR paint on interior	$0.45	SF	420	$189.00
	Interior sheathing	1/2" GWB		SF		$0.00
		Subtotal Cost	**$0.67**	**SF**		**$281.40**
					Enter wall	
	Exterior Walls - Front & Rear Basement				area here	
	New Int Framing	none required				$0.00
	Insulation	Min R-11 foil face, draped full	$0.54	SF	180	$97.20
	Vapor retarder	see above				$0.00
	Interior sheathing	none				$0.00
	Rear Exterior Finish	Parge exist masonry	$3.50	SF	220	$770.00
		Subtotal Cost	**$4.04**	**SF**		**$867.20**
		TOTAL ADDED COST A.				**$1,148.60**
B.	**Party Walls**				Enter wall	
	Side Walls (Party Walls) Assembly - 1st & 2cd floor				area here	
	Structure	Existing wall, crack control				$0.00
	Framing	1-5/8" mtl studs	$0.65	SF	1500	$975.00
	Insulation	Cellulose blown in	$0.36	SF	1500	$540.00
	Interior sheathing	1/2" GWB				$0.00
		Subtotal Cost	**$1.01**	**SF**		**$1,515.00**
					Enter wall	
	Side Walls (Party walls) Assembly - Basement				area here	
	Structure	Brick masonry, existing				$0.00
	Int framing	none				$0.00
	Insulation	min R-11 foil face, draped	$0.54	SF	660	$356.40
	Interior sheathing	none				$0.00
		Subtotal Cost	**$0.54**	**SF**		**$356.40**
		TOTAL ADDED COST B.				**$1,871.40**
C.	**Roof Assembly**				Roof area	
	Roof framing	Existing - assume 2 x 8			or quantity	
	Ceiling framing	2 x 6 wood				$0.00
	Insulation	R-38 "dense-packed" cellulose	$0.20	SF	600	$120.00
	Vapor retarder	Seal joints, VR paint interior	$0.04	SF	600	$24.00
	Sheathing	OSB 3/4" over exist.	$0.82	SF	600	$492.00
	Roofing	3-ply Modified bitumen w/ light coating	$3.50	SF	600	$2,100.00
	Roof ventilation	Turbine	$30.00	EA	2	$60.00
	Finish interior	1/2" GWB				$0.00
		Subtotal Cost	**$4.56**	**SF**		
		TOTAL ADDED COST C.				**$2,796.00**

Assemblies Matrix

D.	**Windows & Doors**				Enter quantity	
	Windows	Alum Th-B, low-E insul.	$85	EA	8	$680.00
	Front door	6-panel insul fiberglass	-$75.00	EA	1	-$75.00
	Rear door	6-panel insul fiberglass	-$75.00	EA	1	-$75.00
	Skylight	Retrofit Double glazing	$80.00	EA	1	$80.00
		TOTAL ADDED COST D.				**$610.00**
E.	**Interior Assemblies**					
	Basement Floor				Area or amt.	
	Floor seal, insulation	Radon seal up, crack control				$0.00
	Radon test	Yes; seal as appropriate				$0.00
	First Floor Assembly				Floor area	
	Joists	Existing wood			here	
	Insulation	none				
	Sub Floor / Deck	Existing T & G wood				$0.00
	Underlayment	Homosote 1.25" T&G	$2.20	SF		$0.00
	Finish Floor - LR, DR	Refinish existing strip wd.				$0.00
	Kitchen, Powder Rm	Linoleum	$2.20	SF	160	$352.00
	(Optional LR, DR)	Recycled PET Berber carpet				$0.00
	Second Floor Assembly				Floor area	
	Joists				here	
	Finish Floor - Bath	Linoleum	$2.20	SF	25	$55.00
	Other rooms	Recycled PET Berber carpet			560	$0.00
	Interior Finish Materials				See units	
	Paint	Low VOC	$0.04	SF	7500	$300.00
	Adhesives	Low- VOC		EA		$0.00
	Wall Tile	Reclaimed ceramic tile	$2.50	SF	76	$190.00
	Trim	Formaldehyde-free MDF	$0.40	LF	500	$200.00
	Counter tops	Site-formed concrete		SF		$0.00
		TOTAL ADDED COST E.				**$1,097.00**
F.	**Appliances/Equip**				Quantity	
	Stove	Electronic ignition gas		EA		$0.00
	Refrigerator	Energy Star, 18 CF	$0	EA		$0.00
	Microwave	Efficient unit		EA		$0.00
	Kitchen vent	Outside venting, 2-speed hood	$75	EA	1	$75.00
	Dishwasher	Energy Star / Water efficient unit		EA		$0.00
	Washing machine	Energy Star / Water efficient unit		EA		$0.00
	Dryer	Energy Star efficient unit (gas?)		EA		$0.00
	Cabinets	Solid wood, non formaldehyde		EA		$0.00
		Subtotal Cost	**$75**			
		TOTAL ADDED COST F.				**$75.00**

Assemblies Matrix

G.	**HVAC Systems**				Quantity	
	Heating	Forced Air, Gas 91 AFUE				$0.00
	Cooling	SEER 13 Condenser	$750	EA	1	$750.00
		1.5 ton				$0.00
	Infiltration/Weather	ACH < 0.5 (0.35 target)	$250	EA	1	$250.00
	Ventilation	Provide timer on bath & Kit vents	$85	EA	1	$85.00
	Ducting	Duct leakage <10%	$175	EA	1	$175.00
	Water Heater (gas)	Demand (gas)	$320	EA	1	$320.00
	Thermostat	Digital clock thermostat (2)	$150	EA	1	$150.00
	Fire Protection	None required; hardwired smoke detectors				$0.00
		Subtotal Cost	**$1,730**	**EA**		
		TOTAL ADDED COST G.				**$1,730.00**
H.	**Plumbing**					
	Water Supply	City			Quantity	
	Bathtub	re-use, refurbish?				$0.00
	Shower	Water-saving head				$0.00
	Sinks					$0.00
	Toilet	Toto 1.6 G/F	$25	EA	2	$50.00
	Kitchen Sink					$0.00
	Outdoor spigot					$0.00
		Subtotal Cost	**$25**			
		TOTAL ADDED COST H.				**$50.00**
J.	**Lighting & Electrical**					
	Service	100 Amp, new breaker panel			Quantity	
	Lighting	Pin-based CFL fixtures (total of 13)	$300	total	1	$300.00
	Ceiling fans	LR, Kit, 2 BRs (4 at $75 each)	$300	total	1	$300.00
	Garbage disposal	none; compost system in place	-$75	total	1	-$75.00
		Subtotal Cost	**$525**			
		TOTAL ADDED COST J.				**$525.00**
	SUMMARY OF MEDIUM GREEN PREMIUM					
		TOTALS OF ITEMS A. THRU J. ABOVE				**$9,903.00**
		Percentage of base case cost of			**50,000**	**20%**
					Budget cost	(Percentage
					fill in	formula)

GREEN BUILDING TEMPLATE - WORKSHEET

	ITEM	Medium Green Upgrade HERS ~86	ADDED COST	UNIT	FILL IN AREA or quantity	TOTALS
		Qualifies for Energy Star Home				
A.	**Exterior Walls**				Enter wall	
	Exterior Walls - Front / Rear at 1st & 2nd Floors				area here	
	Structure	Brick masonry, existing				$0.00
	New Int Framing	1-5/8" metal studs held 3" off brick	-$0.38	SF	420	-$159.60
	Insulation	R-19 Stabilized cellulose filled	$0.60	SF	420	$252.00
	Vapor retarder	VR paint on interior	$0.45	SF	420	$189.00
	Interior sheathing	1/2" GWB		SF		$0.00
		Subtotal Cost	**$0.67**	**SF**		**$281.40**
					Enter wall	
	Exterior Walls - Front & Rear Basement				area here	
	New Int Framing	none required				$0.00
	Insulation	Min R-11 foil face, draped full	$0.54	SF	180	$97.20
	Vapor retarder	see above				$0.00
	Interior sheathing	none				$0.00
	Rear Exterior Finish	Parge exist masonry	$3.50	SF	220	$770.00
		Subtotal Cost	**$4.04**	**SF**		**$867.20**
		TOTAL ADDED COST A.				**$1,148.60**
B.	**Party Walls**				Enter wall	
	Side Walls (Party Walls) Assembly - 1st & 2cd floor				area here	
	Structure	Existing wall, crack control				$0.00
	Framing	1-5/8" mtl studs	$0.65	SF		$0.00
	Insulation	Cellulose blown in	$0.36	SF		$0.00
	Interior sheathing	1/2" GWB				$0.00
		Subtotal Cost	**$1.01**	**SF**		**$0.00**
					Enter wall	
	Side Walls (Party walls) Assembly - Basement				area here	
	Structure	Brick masonry, existing				$0.00
	Int framing	none				$0.00
	Insulation	min R-11 foil face, draped	$0.54	SF		$0.00
	Interior sheathing	none				$0.00
		Subtotal Cost	**$0.54**	**SF**		**$0.00**
		TOTAL ADDED COST B.				**$0.00**
C.	**Roof Assembly**				Roof area	
	Roof framing	Existing - assume 2 x 8			or quantity	
	Ceiling framing	2 x 6 wood				$0.00
	Insulation	R-38 "dense-packed" cellulose	$0.20	SF	600	$120.00
	Vapor retarder	Seal joints, VR paint interior	$0.04	SF	600	$24.00
	Sheathing	OSB 3/4" over exist.	$0.82	SF	600	$492.00
	Roofing	3-ply Modified bitumen w/ light coating	$3.50	SF	600	$2,100.00
	Roof ventilation	Turbine	$30.00	EA	2	$60.00
	Finish interior	1/2" GWB				$0.00
		Subtotal Cost	**$4.56**	**SF**		
		TOTAL ADDED COST C.				**$2,796.00**

D.	**Windows & Doors**				Enter quantity	
	Windows	Alum Th-B, low-E insul.	$85	EA	8	$680.00
	Front door	6-panel insul fiberglass	-$75.00	EA	1	-$75.00
	Rear door	6-panel insul fiberglass	-$75.00	EA	1	-$75.00
	Skylight	Retrofit Double glazing	$80.00	EA	1	$80.00
		TOTAL ADDED COST D.				**$610.00**
E.	**Interior Assemblies**					
	Basement Floor				Area or amt.	
	Floor seal, insulation	Radon seal up, crack control				$0.00
	Radon test	Yes; seal as appropriate				$0.00
	First Floor Assembly				Floor area	
	Joists	Existing wood			here	
	Insulation	none				
	Sub Floor / Deck	Existing T & G wood				$0.00
	Underlayment	Homosote 1.25" T&G	$2.20	SF		$0.00
	Finish Floor - LR, DR	Refinish existing strip wd.				$0.00
	Kitchen, Powder Rm	Linoleum	$2.20	SF	160	$352.00
	(Optional LR, DR)	Recycled PET Berber carpet				$0.00
	Second Floor Assembly				Floor area	
	Joists				here	
	Finish Floor - Bath	Linoleum	$2.20	SF	25	$55.00
	Other rooms	Recycled PET Berber carpet			560	$0.00
	Interior Finish Materials				See units	
	Paint	Low VOC	$0.04	SF	7500	$300.00
	Adhesives	Low- VOC		EA		$0.00
	Wall Tile	Reclaimed ceramic tile	$2.50	SF	76	$190.00
	Trim	Formaldehyde-free MDF	$0.40	LF	500	$200.00
	Counter tops	Site-formed concrete		SF		$0.00
		TOTAL ADDED COST E.				**$1,097.00**
F.	**Appliances/Equip**				Quantity	
	Stove	Electronic ignition gas		EA		$0.00
	Refrigerator	Energy Star, 18 CF	$0	EA		$0.00
	Microwave	Efficient unit		EA		$0.00
	Kitchen vent	Outside venting, 2-speed hood	$75	EA	1	$75.00
	Dishwasher	Energy Star / Water efficient unit		EA		$0.00
	Washing machine	Energy Star / Water efficient unit		EA		$0.00
	Dryer	Energy Star efficient unit (gas?)		EA		$0.00
	Cabinets	Solid wood, non formaldehyde		EA		$0.00
		Subtotal Cost	**$75**			
		TOTAL ADDED COST F.				**$75.00**

G.	**HVAC Systems**				Quantity	
	Heating	Forced Air, Gas 91 AFUE				$0.00
	Cooling	SEER 13 Condenser	$750	EA	1	$750.00
		1.5 ton				$0.00
	Infiltration/Weather	ACH < 0.5 (0.35 target)	$250	EA	1	$250.00
	Ventilation	Provide timer on bath & Kit vents	$85	EA	1	$85.00
	Ducting	Duct leakage <10%	$175	EA	1	$175.00
	Water Heater (gas)	Demand (gas)	$320	EA	1	$320.00
	Thermostat	Digital clock thermostat (2)	$150	EA	1	$150.00
	Fire Protection	None required; hardwired smoke detectors				$0.00
		Subtotal Cost	**$1,730**	**EA**		
		TOTAL ADDED COST G.				**$1,730.00**
H.	**Plumbing**					
	Water Supply	City			Quantity	
	Bathtub	re-use, refurbish?				$0.00
	Shower	Water-saving head				$0.00
	Sinks					$0.00
	Toilet	Toto 1.6 G/F	$25	EA	2	$50.00
	Kitchen Sink					$0.00
	Outdoor spigot					$0.00
		Subtotal Cost	**$25**			
		TOTAL ADDED COST H.				**$50.00**
J.	**Lighting & Electrical**					
	Service	100 Amp, new breaker panel			Quantity	
	Lighting	Pin-based CFL fixtures (total of 13)	$300	total	1	$300.00
	Ceiling fans	LR, Kit, 2 BRs (4 at $75 each)	$300	total	1	$300.00
	Garbage disposal	none; compost system in place	-$75	total	1	-$75.00
		Subtotal Cost	**$525**			
		TOTAL ADDED COST J.				**$525.00**
	SUMMARY OF MEDIUM GREEN PREMIUM					
		TOTALS OF ITEMS A. THRU J. ABOVE				**$8,031.60**
		Percentage of base case cost of			**50,000**	**16%**
					Budget cost	(Percentage
					fill in	formula)

GREEN BUILDING TEMPLATE - WORKSHEET

	ITEM	Deep Green Upgrade HERS 90 Finance added cost w/ EEM	ADDED COST	UNIT	FILL IN AREA or quantity	TOTALS
A.	**Exterior Walls**				Enter wall	
	Exterior Walls - Front / Rear at 1st & 2nd Floors				area here	
	Structure	Brick masonry, existing				$0.00
	New Int Framing	3-5/8" metal studs held 1" off brick	-$0.18	SF	420	-$75.60
	Insulation	5" "AirKrete" (R-19)	$1.90	SF	420	$798.00
	Vapor retarder	None needed		SF		$0.00
	Interior sheathing	1/2" Recycled-content GWB	$0.10	SF	420	$42.00
		Subtotal Cost	**$1.82**	**SF**		**$764.40**
					Enter wall	
	Exterior Walls - Front & Rear Basement				area here	
	New Int Framing	none required (or buyer option?)				$0.00
	Insulation	R-19 foil face, draped full ht.	$0.68	SF	180	$0.00
	Vapor retarder	see above				$0.00
	Interior sheathing	none (buyer option: GWB finish)				$770.00
	Rear Exterior Finish	Fiber Cement Sid'g over 1/2" foam	$3.50	SF	220	$0.00
		Subtotal Cost	**$4.18**	**SF**		**$770.00**
		TOTAL ADDED COST A.				**$1,534.40**
B.	**Party Walls**				Enter wall	
	Side Walls (Party Walls) Assembly - 1st & 2cd floor				area here	
	Structure	Existing wall, crack control				$0.00
	Framing	1-5/8" mtl studs	$0.65	SF	1500	$975.00
	Insulation	"Air-Krete" (R-5.5)	$0.83	SF	1500	$1,245.00
	Interior sheathing	1/2" Recycled-content GWB	$0.10	SF	1500	$150.00
		Subtotal Cost	**$1.58**	**SF**		**$2,370.00**
					Enter wall	
	Side Walls (Party walls) Assembly - Basement				area here	
	Structure	Brick masonry, existing				$0.00
	Int framing	Plastic lumber furring 2"				$0.00
	Insulation	2" "Air-Krete" (foamed behind screen)	$1.00	SF	660	$660.00
	Interior sheathing	none (buyer option: GWB finish)				$0.00
		Subtotal Cost	**$1.00**	**SF**		**$660.00**
		TOTAL ADDED COST B.				**$3,030.00**
C.	**Roof Assembly**				Roof area	
	Roof framing	Existing - assume 2 x 8			or quantity	
	Ceiling framing	None; cathedral ceiling	-$0.30	SF	600	-$180.00
	Insulation	8" "Air-Krete" (R-31)	$4.00	SF	600	$2,400.00
	Vapor retarder	None (Note 3)				$0.00
	Sheathing	Certified OSB 3/4" over exist.	$0.82	SF	600	$492.00
	Roofing	Energy Star membrane	$5.00	SF	600	$3,000.00
	Roof ventilation	Turbine	$30.00	EA	0	$0.00
	Finish interior	1/2" Recycled-content GWB	$0.10	SF	600	$60.00
		Subtotal Cost	**$9.62**	**SF**		
		TOTAL ADDED COST C.				**$5,772.00**

D.	**Windows & Doors**				Enter quantity	
	Windows	Fiberglass low-E Argon fill	$100.00	EA	8	$800.00
	Front door	6-panel insul fiberglass	-$75.00	EA	1	-$75.00
	Rear door	6-panel insul fiberglass	-$75.00	EA	1	-$75.00
	Skylight	Solar tube plus new one in Bathroom	$250.00	EA	1	$250.00
		TOTAL ADDED COST D.				**$900.00**
E.	**Interior Assemblies**					
	Basement Floor				Area or amt.	
	Floor seal, insulation	New insulated slab and perim, Radon prevention measures	$1.00	SF	600	$600.00
	Radon test	Yes; seal as appropriate		EA		$0.00
	First Floor Assembly				Floor area	
	Joists	Existing wood			here	
	Insulation	3" cotton batts	$1.20	SF	600	$720.00
	Sub Floor / Deck	Existing T & G wood				$0.00
	Underlayment	Homosote 1.25" T&G	$2.20	SF		$0.00
	Finish Floor - LR, DR	Refinish existing strip wd.				$0.00
	Kitchen, Powder Rm	Recycled glass ceramic tile	$5.50	SF	160	$880.00
	(Optional LR, DR)	Area rugs on wood floor				$0.00
	Second Floor Assembly				Floor area	
	Joists				here	
	Finish Floor - Bath	Recycled glass ceramic tile	$5.50	SF	25	$137.50
	Other rooms	Area rugs on wood floor	-$1.40	SF		$0.00
	Interior Finish Materials				See units	
	Paint	Low VOC	$0.04	SF	7500	$300.00
	Adhesives	Low- VOC		EA		$0.00
	Wall Tile	Recycled glass ceramic tile	$5.50	SF	76	$418.00
	Trim	Formaldehyde-free MDF	$0.40	LF	500	$200.00
	Counter tops	Recycled plastic board	$1.00	SF	44	$44.00
		TOTAL ADDED COST E.				**$3,299.50**
F.	**Appliances/Equip**				Quantity	
	Stove	Electronic ignition gas		EA		$0.00
	Refrigerator	Ultra-efficient (e.g., Eco-Fridge)	$700	EA	1	$700.00
	Microwave	Vented unit - double as range hood	$125	EA	1	$125.00
	Kitchen vent	See above	$0	EA		$0.00
	Dishwasher	Water, energy efficient		EA		$0.00
	Washing machine	Combo washer / dryer	$250	EA	1	$250.00
	Dryer	(e.g., Equator brand)	$0	EA		$0.00
	Cabinets	Solid certified wood		EA		$0.00
		Subtotal Cost	**$1,075**			
		TOTAL ADDED COST F.				**$1,075.00**

G.	**HVAC Systems**				Quantity	
	Heating	Forced air, solar HW combo unit	$450	EA	1	$450.00
	Cooling	SEER 15 condensor	$1,500	EA	1	$1,500.00
		1.5 Ton				$0.00
	Infiltration/Weather	ACH +/- 0.2 & mech ventilation	$350	EA	1	$350.00
	Ventilation	Provide timer on bath & Kit vents	$85	EA	1	$85.00
	Ducting	Duct leakage = 0	$175	EA	1	$175.00
	Water Heater (gas)	Demand (gas) backup to solar	$320	EA	1	$320.00
	Thermostat	Digital clock thermostat (2)	$150	EA	1	$150.00
	Fire Protection	Fully Sprinklered - option	$1,800	EA	1	$1,800.00
		Subtotal Cost	**$3,030**	**EA**		
		TOTAL ADDED COST G.				**$4,830.00**
H.	**Plumbing**				Quantity	
	Water Supply	City water: Particle, and Active Carbon canister filtration	$350	EA	1	$350.00
	Bathtub			EA		$0.00
	Shower	Water-saving head		EA		$0.00
	Sinks			EA		$0.00
	Toilet	Dual flush 0.8 / 1.6 GPF	$175	EA	2	$350.00
	Kitchen Sink			EA		$0.00
	Outdoor spigot	none; use rainwater catchment		EA		$0.00
		Subtotal Cost	**$525**			
		TOTAL ADDED COST H.				**$700.00**
J.	**Lighting & Electrical**				Quantity	
	Service	100 Amp, new breaker panel				$0.00
	Lighting	Pin-based CFL fixtures (total of 13)	$300	total	1	$300.00
	Ceiling fans	LR, Kit, 2 BRs (4 at $75 each)	$300	total	1	$300.00
	Garbage disposal	none; compost system in place	-$75	total	1	-$75.00
		Subtotal Cost	**$525**			
		TOTAL ADDED COST J.				**$600.00**
	SUMMARY OF DEEP GREEN PREMIUM					
		TOTALS OF ITEMS A. THRU J. ABOVE				**$21,740.90**
		Percentage of base case cost of			**50,000**	**43%**
					Budget cost fill in	Percentage formula)

FLASHING is a metal, fabric or other material that is used to seal, weatherproof or otherwise prevent moisture from penetrating joints in a building, on a roof or at wall openings.

Energy Terms:

SEER(2): Seasonal Energy Efficiency Ratio – Measures the cooling efficiency for an electric heat pump unit. Industry standard is SEER 10 0r 11, but higher is better up to about a SEER 15.

EER(2): Energy Efficiency Ratio. – Used to measure cooling efficiency of room air conditioners. A measurement of the output in Btu divided by the watt/hr of electricity input. October 2000 a new standard went into effect requiring new room air conditions to have a EER of 10.

COP(2): Coefficient of Performance – a measurement of the efficiency of an electric heat pump in the heating mode, expressed as the ratio of energy consumed to energy produced. A range of 1.5 to 3.5 is average. Used on geothermal or "ground source" heat pumps.

HPSF(2): Heating Season Performance Factor – a measurement of heating efficiency for air-source, electric heat pumps by taking the ratio of the estimated seasonal output (Btu) divided by the seasonal power consumption (watts).

AFUE(2): Annual Fuel Utilization Efficiency – Measurement of a gas heating system's efficiency (ratio of the amount of heat output compared to the input of energy required) including accounting for performance in real operating conditions such as start up, cool down, etc. Generally 80% AFUE is a minimum and the higher the number the better the fuel savings.

(2) footnote from Consumer Guide to Home Energy Savings by Alex Wilson and John Morrill, ACEEE publication, 6th Ed. 1998.

APPENDIX B.2: Sources

The following pages is a summary matrix for sources locating alternative, environmentally preferred building materials, appliances and equipment for creating a "green" home. The authors of the Green Building Template do not guarantee, recommend or warranty any of the selections listed in this Materials Matrix. Nor is the list any kind of endorsement for the products, manufacturers or distributors listed. The Materials Matrix is provided **for reference only** and should be used as a starting point for locating regionally available building materials.

Each house is different, with different budgets and the respective developer or homeowner should research their own building materials and install the proper materials for the given application.

Under development are two local resource directories

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And a good source for affordable housing recycling and salvaged construction materials is the non-profit organization called the Loading Dock

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The authors of the Green Building Template, as listed in Appendix A.1 welcome feedback on the Materials Matrix, pricing information and experiences with the products or distributors. Please address comments to Julie E. Gabrielli at the address listed in the Project Directory.

	SOURCES FOR MATERIALS AND PRODUCTS		08-Oct-01					
*	Indicates item included on Worksheet (for Light, Medium, or Deep Green alternates)							
	SECTION	**ITEM**	**MFG**	**PRODUCT NAME**	**SOURCE (Distributer)**	**COST**	**Enviro Benf.**	**Notes**
	1.0 General Conditions							
	2.0 Sitework							
	Porous Concrete Pavers	Uni-Ecostone	Balcon, Inc Crofton, MD 800-580-5838		Andy Crouch Sales Rep andy.crouch@oldcastleapg.com	$15 to 18/SF installed	Less surface water run off, water percs thru paving	
	Plastic Fencing	See Plastic Lumber listing below (Section 6)						
	Rain Barrel Collectors	Roof runoff rainwater harvesting	??	Great American Rain Barrels, 60 gal capacity	Jade Mountain 800-442-1972 www.jademountain.com	$120 incl shipping	Made from Recycled plastic, comes in three natural colors	
			D & P Industries Inc. (DPI)	Urban Rain Barrel (holds 57 gallons)	(503) 286-9866 or www.therainbarrel.com	$90 over Internet plus shipping	Recycled Food Grade Barrel	
			Spruce Creek Co.	Spruce Creek Rainsaver (54 gall.)	800-940-0187 or www.sprucecreekrainsaver.com	$135 plus $18 shipping		
	3.0 Concrete							
	Concrete sealers	Concrete floor or slab sealer	SEAL-KRETE		HQ= Florida 800-323-7357, www.seal-krete.com		Water based, low VOC sealers designed to withstand FL sun	Exterior use design to last over 5 years, generally less than 100 g/l VOC
		Concrete floor or slab sealer	CemBond Paint	San Diego, CA 800-239-0321	www.afmsaafecoat.com		Water based, low VOC (28 g/lsealers designed to withstand FL sun	Primarily recommended for vertical surfaces
		Concrete and masonry sealer	Palmer Industries Frederick, MD 301- 898-7848	9400 Impregnant	Doug Palmer; Palmer Industries; Frederick, MD 301-898-7848		Water based, low VOC, minimizes mold & mildew growth, breathable	Coverage 100 to 150 square feet per gallon. Also available in formula for wood.
	4.0 Masonry	NOT USED THIS SEARCH						
	5.0 Metals	NOT USED THIS SEARCH						
	6.0 Wood and Plastics							
*	Certified Wood Supplier	Wood certified by an indep 3rd party as being sustainably harvested from managed forests			Portsmouth Lumber 2511 High St Portsmouth, VA 23707 757-397-4646(P)			Can custom mill finish wd prod and plywood; contact Earl Williams
*		FSC Certified Lumber, mill goods			Kane Hardwoods in Kane, PA, 814-837-6941		Within 300 mile radius of Baltimore	
*		FSC Certified Lumber, plywood, mill goods			Lewis Lumber Products www.lewislp.com or contact Wayne at 800-233-8450		Within 300 mile radius of Baltimore	
*		FSC Certified "Smartwood" Lumber, plywood, mill goods			Northland Forest Products Manassas, VA. Contact Warren Bickley, 703-393-7500		Within 300 mile radius of Baltimore	
	ENGINEERED WOOD PRODUCTS TJI Joists (formaldehyde free)	Engineered wood product using LSL fiber and MDI binders.	Trus Joists MacMillam Boise Idaho 800-3380515 www.tjm.com	Wood I-joist with "Timberstrand" LSL	NATIONAL LUMBER Baltimore, MD 410-675-4740		Conserve virgin Mat'l Indoor Air Quality	Formaldehyde Free binder and LSL strand material, fast growing trees mfg into long strand fibers - more efficient use of timber

	SECTION	ITEM	MFG	PRODUCT NAME	SOURCE (Distributer)	COST	Enviro Benf.	Notes
	Sheathing	Sheet goods not used for structural should be made from Enviro Pref product such Cert Plywd or use alt framing to replace shtg.	Collins Wood Certified Plywood Portland OR 800-329-1219 or www.CollinsWood.com	Certified Plywood			Conserve virgin Mat'l Indoor Air Quality	Int and Ext Plywood use phenol formaldehyde binder. Made from certified forest products. OSB and Plywood are not as EP as using let-in bracing or FSC Cert Plywood
*	Floor decking/Underlayment	Structural high-density fiberboard panels, T & G, multi-ply subfloor, sound deadening and insulation value of R2.5/in	Homosote, Inc West Trenton, NJ 800-257-9491 or www.homasote.com	4 -way Floor Decking 440 Soundbarier 440 Carpetboard	NATIONAL LUMBER Baltimore, MD 410-675-4740		Made from 100% recycled content w/parafin binders & insulative	
	Thermo-Ply	Structural Sheathing Panel	Simplex Products Division Adrian, MI 800-345-8881 or	x	x			100% recycled fiber and al foil, 1/8" thick but still provides bracing.
	Arsenic Free Pressure Treated Wood	Fencing, Wood Foundations, Decking other PT wood uses	Preserve Plus 200 E Woodlawn Rd Charlotte, NC 28217 704-522-0825	"Preserve" treated wood	NATIONAL LUMBER Baltimore, MD 410-675-4740 - CCA Wood		ACQ environmentally preferable treatment	
	Composite Plastic & Wood decking	Dimensional Lumber made from recycled wood fiber and recycled LDPE Plastic (Grocery Bags)	Trex Easy Care Decking Winchester, VA www.trex.com	Trex Easy Care Decking	Smoot Lumber TW Perry Home Depot?		100% recycled, Durable, Low Maint. CONCERN: "downcycled," not easy to recycle	Largest producer of plastic lumber in USA; widely available
*	Plastic Lumber	Alternative to treated lumber	Phoenix Recycled Plastic	Foreverdeck	Phoenix Plastic; Ambler, PA www.plasticlumberyard.com or 215-653-0300		100% recycled plastic, not mixed with wood	Use for decking, fencing, sill plates, furring on masonry. Verify stuctural loads.
*		Alternative to treated lumber	Resco Plastics	MaxiTuf	Resco Plastics, Coos Bay, OR (541-269-5485) www.rescoplastics.com	(quotes through website)	100% recycled plastic, not mixed with wood	Use for decking, fencing, sill plates, furring on masonry. Verify stuctural loads.
	Wood Trim	Reclaimed mouldings are available mostly for historic apps, Medite makes a trim element	Sierra Pine www.sierrapine.com	Sierra Pine MDF Moulding	Perry's Lumber and Supply			Sierra Pine Moulding made in CA? but do have east coast mfg capability
	Wood Trim	Finger Jointed Molding			NATIONAL LUMBER Baltimore, MD 410-675-4740	Less than clear pine or poplar molding	Efficient resource use of scrap wood and molding material	Sending KSA a profile brochure
	Wood Trim	Exterior use, engineered wood product	Temple-Inland HQ=Dallas TX	TrimCraft	Werhouser(?), Richmond VA 501-624-8465 or Vartan in Harrisburg, PA 717-652-2200		Made from wood byproducts of Southern pine sawmills. Ggreen wood chips and pine residue formed into 4'x8' sheets	
	Construction Wood & Plastic Adhesives	Plastic Laminate and general construction glue	TITEBOND Solvent Free Construction Adhesive Polymer Adhesive, medium density	Franklin International 800-669-4583	Perry's Lumber and Supply - In stock			
*	Plastic Laminate Countertop Alternatives	Cementitious board (stone-look)	American Fiber Cement Corporation 800-688-8677	SLATESCAPE	Fireslate Co., Lewiston, ME 800-523-5902 (Tom Worthen) OR Niagra Insulation 716-852-5655 (Bill Stamp)	1" thick = $29 /sf 3/4" thick = $24/sf	Fiber cement based product that has the look, feel and mass of natural stone	websites: www.americanfibercement.com and www.fireslate.com
*		Recycled plastic sheet goods	Yemm & Hart	ORIGINS	Yemm & Hart, Madison, WI 573-783-5434	1" x 4' x 8' sheet is $903 ($28 / sf)	100% recycled high density polyethylene	Available in variety of colors and thicknesses
*		Concrete formed on-site	None	None	Local artisans or do-it-yourself	Varies	Papercrete countertops - 60% newspaper pulp, 10% cement, 30% sand	Fine Homebuilding magazine has advice on concrete countertops in Sept 1999 issue, pg. 62 ff.

	SECTION	ITEM	MFG	PRODUCT NAME	SOURCE (Distributer)	COST	Enviro Benf.	Notes
	7.0 Thermal & Moisture Protection							
	Fiber Cement Siding	Certainteed Fibercement Siding	Certainteed Valley Forge, PA 800-233-8990	WEATHERBOARDS Fibercement Siding	The Roof Center, Inc Alexandria, Manassas 1-800-941-6402 (Jimmy or Otis)	Ranges from $75 to 130/square material costs	ITS NOT VINYL RCM material??	CertainTeed now owns "Wolverine" Siding which also has a cement fiber siding Recommend factory primed board,
		Hardiboard Cementitious Siding	James Hardie Siding Materials, Mission Viejo, CA 888-542-7343	HARDI PLANK or HARDIE Shingleside	Perry's Lumber and Supply - In stock		ITS NOT VINYL RCM material??	Can get factory pre-painted by a 3rd party vendor but not recommended due to damage or scratches during installation.
*	Wall Insulation	Recycled - Content Fiberglass Batts	Johns Manville or Certainteed					
*		Stabilized Cellulose Insulation	GreenStone Louisianna Pacific	GREENSTONE "COCOON"	Lowes, Home Depot		100% RCM, local company overing the product	Probably most beneficial wall and ceiling insulation for L'Arche, GreenStone gives 53sf/bag coverage
*		Stabilized Cellulose Insulation			Cary Insulation of Maryland / Masco Eastern Division Finksburg 410.833.9301			
*		Stabilized Cellulose Insulation			Applegate Manufacturing, Hagerstown, MD, 301-791-7360			
		Blown-in Fiberglass Insulation	CertainTeed	INSULASAFE 4 FIBER GLASS BLOWING INSULATION	Southland Insulators Hyattsville, MD ? Jerry @301-368-1965		Blowable Fiberglass	
*		Foamed in place	Palmer Industries Frederick, MD 301-898-7848	AIR-KRETE	Palmer Industries www.palmerindustries.com and www.airkrete.com	$0.40 to $0.60 a "board-foot" installed	Non-toxic, cementitious, fireproofing. Excellent air sealer, because foamed in.	Price depends on complexity. Foams in, needs support of light screening or drywall. R-3.9 per inch
*		Cotton batts	Bonded Logic www.bondedlogic.om	ULTRA-TOUCH	Advanced Fiber, Cincinatti, OH, 513-860-4446 (rep: Doug Lewthold)	2 x 4 (R-13) $0.50/sf material only 2 x 6 (R-19) $0.62/sf	85% is recycled scraps from clothing manufacture, plus fillers	Additives include borates for fire resistance, PE (plastic) binder fibers. Recommended for acoustic insulation.
	Rigid Insulation	Ozone-friendly rigid insulation	Tri-State Foam Martinsville, VA 540-638-3592 w3.tri-state-foam.com	AFM EPS Rigid Board Insulation	??	$.88/SF installed?	Rigid Foam product with high R value and lower enviro impact during mfg. Min greenhouse gas & ozone depletion thru pentane gas recovery	
	Sealants for Air Infiltration	Sealing Foam	Convenience Products Fenton, MO 800-325-6180 www.convenienceprod	TOUCH 'n FOAM	True Value Hardware Stores, Home Depot (maybe)		HCFC-free foam sealant available in disposable cans	
	Caulk and Sealants	Silicone Caulks	STP Super-Tek Specialty Adhesives 718-278-7900 www.super-tek.com	DOW CORNING 795 Silicone Bldg Sealant	Resource Conservation Technology, Baltimore, MD 410-366-1146 (for Dow prod)			STP Super-Tek also makes a Contact Adhesive and EPS Adhesives
		High Performance Caulk and Sealant	Phenoseal Gloucester Co. Franklin MA 800-343-4963	SURPASS High Performance Caulk and Sealant	??		Uses 25% Post-consumer RCM in packaging. No PVCs	Seals and bonds for windows/doors, caulk for tubs, tiles etc. Comes in colors
		Polyurethane Caulks and Sealants		SIKAFLEX-1a				

	SECTION	ITEM	MFG	PRODUCT NAME	SOURCE (Distributer)	COST	Enviro Benf.	Notes
*	Acrylic roof coating	White highly reflective coating for use on built-up roofs or modified bitumen.	Mule Hide Products www.mulehide.com	MH A-320 Acrylic Finish Coating for Asphaltic Substrates	ABC Suppliers North Baltimore; 3901 Buena Vista Ave; 410-366-5151		Extends life of B.U.R. without need for tear-off. Warranty up to 10 years between coatings	Used on Philadephia's Cool Roofs program
*			ACRYMAX; Media, PA 610-566-7470 www.acrymax.com	Acrymax				
*			Uniflex Professional Roof Coatings; Medina, OH, 888-321-3539					
	8.0 Doors and Windows							
*	Replacement Windows	Al or vinyl clad, insulated replacement windows	Weathershield		Perry's Lumber and Supply		Energy efficiency, Do not use vinyl windows, prefer Al clad and most durable	Linda Notter from Perry's noted that this is probably the best quality line for the price they sell. Alloww 4-6 weeks for delivery; Perrys does not rep fiberglass windows
*		Fiberglass Replacement Windows	Marvin "Integrity Line	"Ultrex" , milled wood finish interior face, low-e	The Windows and Door Planning Centre 1430 Joh Avenue, Suite D Baltimore 410-242-3000	$250.00 for IDH3060 unit (2'-6" x 5"-0")	Durable, low mtce, fiberglass frame expands & contracts at same rate as the glass	Contact Terry Kimball Glass fiber and polyester resin
*		Aluminum, thermally broken, insulating	Champion					
*	Skylights and Roof Windows	Operable roof window/ skylight	Velux Roof Windows		Perry's Lumber and Supply		Operable for venting	
*		Tubular Skylights	HUVCO tubular skylight	DAYLIGHT	Huvco, Ijamsville, MD 301-865-6798 or 800-832-6166 www.huvco.com		Manufactured in MD, more light, less energy loss with a tubular skylight	
	Interior Wood doors	Re-used doors ???			Loading Dock Baltimore, MD		Best option from enviro perspective but may add to cost, availability?	
		Chain-of-custody Certified wood doors	A.E. Sampson & Sons Warren, ME 800-769-6196	Interior Doors			Do not use LUAN veneer doors, (from tropical forests) Use sustainably harvested woods	Recommend wood doors for interior use
		FSC Certified solid hardwood doors, Interior and Exterior	Allegheny Wood Works, INC Lake City PA 814-774-7338				Certified green doors, solid hardwood	
		Masonite CraftMaster Doors	Masonite Company				Wood fiber and resin, compressed under intense heat & pressure.	
	Exterior Wood Doors	FSC certified Santa Cruz Collection White Mahogany Doors or Premier Oak	Streuli Sales, Inc					
	Fusion Crafted Wood Door		Alterna by DoorCraft, Inc	Wood exterior & interior doors	Iron City Sash & Door Baltimore, MD 410-247-6611			
*	Exterior Metal Insulated Doors	Jeld-Wen is primary company, HQ in Oregon?	Alterna by DoorCraft, Inc	Exterior Mtl doors	Iron City Sash & Door Baltimore, MD 410-247-6611		Have EPS foam core instead of Polyurethane, needs to be painted	

	SECTION	ITEM	MFG	PRODUCT NAME	SOURCE (Distributer)	COST	Enviro Benf.	Notes
	9.0 Interior Finishes							
	Underlayment for floating floors	Recycled content underlayment made from old tires	EcoTimber 1020 Heinz Avenue Berkely CA 94710 www.ecotimber.com	DURAFIT 500		$4.00 /SY	RCM	Top face = woven polyjute, bottom face= flat premium recycled rubber. This Co also has many wood supplies but is only located in CA?
	Underlayment and Ceramic tile backer board	Cementitious Backer board	James Hardie Siding Materials, Mission Viejo, CA 888-542-7343 www.jameshardie.co	HARDIBacker	Maybe from Perry's Lumber			
	Gypsum Wall Board							
		Gypsum Wall Board: US Gypsum	US Gypsum Co* HQ = Chicago, IL 800-874-4968	Fiberock, Sheetrock, DUROC			GWB made w/synthetic gypsum is more available but harder to work and a little more brittle, If mfg from a plant nearby might be worth using.	Fiberock by USG is abuse resistant and has better thrermal mass. Made w/perlite and recycled newsprint for increased fiber reinforcement
		Gypsum Wall Board: Temple Inland	National Gypsum Co.* HQ in Charlotte, NC	Green Certified Wallboard	Closest distr.= Harrisburg, PA or Richmond, VA Weyerhouser 501-624-8465		All T-I wallboards average 60% recycled content, from TN plants can get 95 to 99% RCM board.	USG, G-P & T-I make 54" wide sheets for 9' ceiling hghts
		Gypsum Wall Board: Georgia Pacific	G-P (Georgia Pacific) Gypsum Co.* HQ = Atlanta GA 404-652-4000	Gypsum Board, Dens-Glass Gold ToughRock			Paper facing = 100% recycled; Gyp core at least 10 to 15% Post-I waste by weight? **Savanah GA plant makes GWB w/40% Synth Gyp**	Exterior wall sheathing called Dens-glass. Toughrock = bleached paper and heavier thickness for surface = less paint
	Joint Compound	Joint Compound for GWB	MURCO Wall Products,Ft Worth TX 817-626-1987 www.murcowall.com	MURCO M100 25# bags shipped from factory	Closest distributer = in Tennessee1-931-363-5851	$__/25# bag	Low VOC, water based compound	
*	Wall Tile	Recycled Content Tile	Environmental Stone* 888-629-1969 Allentown, WI					
*		Recycled glass ceramic tile	Terra Green Ceramics, Inc., Richmond, Indianna, 756-935-4760	TerraGreen Ceramic Tile	Dal-Tile, Linthicum 410-636-7012	$5.57 / sf Standard Color	58% Recycled Glass	4x4 to 24 x 24 tiles; Three product lines
	ADHESIVES							
	Adhesive	General construction contact adhesive	AFM SAFECOAT Santa Fe Springs, CA	SAFECOAT 3 in 1	http://www.healthye.com or contact Paul at 1-800-238-5008	$189.95 / 5gal from website	low odor & low VOC no formaldehyde	
	Ceramic Tile Adhesive	Dap D-50 and D-40 Latex Fortified Mortar	DAP, Inc*		Area distributers			Verify compatibility with particular tile product prior to use
	Adhesives: Plastic Laminate and general construction glue	Polymer Adhesive, medium density	Franklin International 800-669-4583	TITEBOND Solvent Free Construction Adhesive			Solvent free, contains no ozone depleting materials	

	SECTION	ITEM	MFG	PRODUCT NAME	SOURCE (Distributer)	COST	Enviro Benf.	Notes
	FLOORING							
*	FSC Wood Flooring	Oak, pine, strip flooring		A E Sampson & Son 171 Camden Rd Warren ME 800-769-6196			From FSC certified wood from Sustainably managed forests in Maine	E-mail: sampsnwood@aol.com
*	Salvaged / reclaimed wood flooring	Salvaged / reclaimed wood			Search on www.recycle.net or inquire at The Loading Dock, Baltimore		Salvaged wood from old growth forests, instead of using new	
		Strip wood flooring made from reclaimed woods	Vintage Lumber		Vintage Lumber Co., Woodsboro, MD 800-499-7859		Engineered product uses reclaimed wood efficiently	Showroom in Woodsboro is near Frederick, MD; contact Glenn Legore
	Bamboo Flooring	Bamboo Flooring	Jade Mountain Supply	3.5" widex		$5/sf starting price	Renewable Resource	Top face = woven polyjute, bottom face= flat premium recycled rubber. This Co also has many wood supplies but is only located in CA?
*	Reslient Flooring (kitchens, bathrooms)	Linoleum sheet or tile	Forbo Industries Distrib Hazelton, PA Mfg overseas	MARMOLEUM	Forbo Industries, 800-842-7839 website is www.forbo-industries.com		Rapidly renewable cork based, wood flour, linseed oil, jute backing, non-petroleum based product	Very durable if properly cared for. Not suitable for very wet areas (basically a wood-based product).
	Reslient Flooring (kitchens, bathrooms)	Floor tile or Sheet goods	Amica UK Mfg but sched for US production in Atlanta Summer '01	STRATICA	RHI 7397 Washington Blvd Elkridge, MD 301-498-7087	$7.75/SF installed	Chlorine Free, VOC free, Recyclable, No plasticisers used in the mfg.	Expensive and requires long lead time.
*	Floor Tile	Recycled glass ceramic tile	Environmental Stone*	Environmental Stone*	Environmental Stone* 888-629-1969 www.environmentalstone.com, Allentown , WI		100% post-consumer recycled glass, looks like natural stone	12"x12" to 24" x 24" Slip resistance
*		Recycled glass ceramic tile	Terra Green Ceramics, Inc., Richmond, IN, 756-935-4760	TERRA CLASSIC, TERRA TRAFFIC, TERRA ACCENTS	Dal-Tile, Linthicum 410-636-7012	$5.57 / sf Standard Color	58% Recycled Glass content	4x4 to 24 x 24 tiles; Three product lines
		PermaGrain Flooring	PermaGrain Products, Inc	CONFETTI and SPLASH	Lizzote Assoc Edgewater, MD 800-828-6488		95% postindustrial for "confetti" and 10% recycled plastic for "splash"	
	CARPET							
*	Carpet - generally broadloom	Milliken "Earth Square"	Milliken Carpet	Earth Square carpet tiles	Carrie Wice 800-257-3987			Commercial grade that works in residential setting, Will wear better, be more stain resistant, and can get an antimicrobial if needed
*		PET Carpeting	Mohawk	ENVIRO-TECH or KIDS AT PLAY	All-Ways Carpets, Timonium, MD, 410-308-9898	varies	100% PET recycled; CONCERN: offgassing poses IAQ hazards	Not a commercial grade? May not wear as well as carpet tiles
*		Collins and Aikman				$17.00 to $30 SY installed	Excellent Enviornmental record as a company. Powerbond backing is a dry tack, no VOC peel off system	
*		Shaw Olefin	Shaw /Olefin Georgia	Shaw / Olefin	Kemper Carpets 1245 Rockville Pike Rockville MD (301) 231-6300	$2.90 SF Installed	Stain Resistant Loop Carpet	

	SECTION	ITEM	MFG	PRODUCT NAME	SOURCE (Distributer)	COST	Enviro Benf.	Notes
	PAINTS AND COATINGS							
*	Indoor Paints, trim, wall, ceiling	Indoor Paints	Benjamin Moore New Jersey	Eco Spec	Budeke's 418 S. Broadway 410-732-4354	≈$31.00 / Gallon plus tax	No Volatile Organic Compounds (VOCs)	
*		Primer	Benjamin Moore New Jersey	Eco Spec Latex Prime Sealer	Budeke's 418 S. Broadway 410-732-4354	$23.28 / gal	No Volatile Organic Compounds	
	Paint Stripper	Stripper	Back to Nature Englishtown, NJ	READY-STRIP	MAB PAINTS (202) 966-5445	$29.99 / gal	Biodegradble, nonflammable, odor-free, no methylchloride orother dangerous chemicals	
*	Vapor Retarding Prime Coat	Vapor Retarding Prime Coat	Palmer Industries Fredrick, MD 800-545-7383	86001-SEAL	Doug Palmer Palmer Industries Fredrick, MD 301-898-7848	$24.95 / gallon	Vapor barrier protects insulation and structure from moisture	Primer spray or roll on acts as a vapor barrier. Substrate makes a smooth surface for any paint finish coat.
*	Vapor Retarding Paint							
*	Wood Floor Finish	Low VOC sealers also can be used for finishing wood floors, etc.	SAFECOAT Santa Fe Springs, CA 619-239-0321	SAFESEAL & HARDSEAL	http://www.healthye.com or Contact Paul at 800-238-5008	Safeseal - $129.95 / 5gal Hardseal - $134.00 / 5gal	Safeseal - seals processed wood from offgassing Hardseal - seals wood for finishing & prevents further offgassing	
*		Stain	SAFECOAT Santa Fe Springs, CA	SAFECOAT - Durastain	http://www.healthye.com or ECO (Paul) 1-800-238-5008	Depends on type		
		Low VOC wood floor finish						

	SECTION	ITEM	MFG	PRODUCT NAME	SOURCE (Distributer)	COST	Enviro Benf.	Notes
	Appliances & Mech							
	KITCHEN	**Gas Stove**	Recommend getting same brand as other appliances				NOTE: See attached Appliance Summary for notes	No particular efficiency rating for gas stoves. Self cleaning conventional is most efficient with window in door
		Refrigerator/Freezer	Maytag 18.5 cf	MTB 1956 BE			527 kWh / yr w/ auto icemaker	Note: Appliances selected from ACEEE or EPA Energy Star listings.
		RFG Side By Side Upright 24 to 26 cu ft	Amana 24.8 cu ft	SZD25S5			765 kWh/yr	ACEEE list/ energy cost est=$65/yr
		RFG Side By Side Upright 24 to 26 cu ft	Kitchen Aid 26.5cf	KSU*27QD**0*			658 kWh/yr	ACEEE list/ energy cost est=$ 56/yr
		Top Freezer style	General Electric 14.4cf	GE TBH 14*			496 kWh/yr	ACEEE list/ energy cost est=$ 42/yr
*		Ultra-efficient refrigerator	Vestfrost	Eco-Fridge	Order thru Internet www.oasismontana.com	$980	340 kWh/yr or less	
		Dishwasher	Amana	DWA53A		518 kWh/yr	80% of energy use goes into heating the water	
			General Electric	GSS1800^		451 kWh/yr		
			Kitchen Aid	KUDIO1TJ		526 kWh/yr		
	LAUNDRY	**Clothes Washer**	General Electric 2.65 cf capacity	WSXH208TWB^		264 kWh/yr	Recommend front loading or horizontal axis for greatly improved energy eff and water conserv.	^ indicates on both EPA and ACE[3] lists
			Maytag 2.9 cf	MAH4000^			282 kWh/yr	
			Frigidaire	FWT 449 GFS		$700 (incl. $100 manuf rebate)	275 kWh/yr Horizontal axis saves water	
		Clothes Dryer	Frigidaire	FDG 546 RES			Gas, w/ auto shutoff	Look for units w/ moisture sensors, which are more efficient. May not be readily available.
*		**Clothes Washe / Dryer in one unit**	Equator	Equator	Cummins Appliance 1708 Reisterstown Rd. 410-484-1333	$890 for 10-lb $945 for 13-lb capacity	Saves water and energy.	Single unit conserves space, does not require outside venting. Caveat: requires homeowner training in
	AIR CONDITIONERS (See also mech for Trane info)	**Room Air Conditioning Unit** Most models come as thru wall or window unit	Whirlpool 10000 Btu/h	ACQ102R*O (115v)		10.0 EER	want 9.5 to 12.6 EER's rating, most can be ordered as window or thru wall	Do not recommend Friedrch brand, recommend getting all same brand units for easier mtce.
			White Westinghouse 8000 Btu/h	WAK083F7V (115v)		10.5 EER		
			White Westinghouse 18,800 Btu/h	WAS18**2A (230v)		9.5 EER		
			Panasonic 20,300 Btu/h	CW-C200NU (115v)		11.0 EER		
			Amana 25,000 Btu/h	(230v)		9.5 EER		
		Central Air Conditioning	York	H4TS030S06		15.0 SEER		
			Lenox	HS27-030-1P		__ SEER		
*	WATER HEATERS	**Demand Water Heaters**	Rinnai America	2440	RinnaiAmerica (800) 621-9419	$550	Heats hot water only when needed; can be coupled w/ heating system	Size based on number of sinks; verify unit prior to order. Compatible w/ gas, this unit mounts and vents
*			Aqua Star					Similar type unit, but mounts inside and vents to outside.
*		**Efficient Tank Heaters**						

	SECTION	ITEM	MFG	PRODUCT NAME	SOURCE (Distributer)	COST	Enviro Benf.	Notes
	Plumbing Fixtures							
	PLUMBING FIXTURES	Kitchen Sink	American Standard				Select cast iron for high recycled content	3 compartment allows most flexibility for rinsing, veggie washing
		Still making this???	Kohler	Eco-Cycle Sink	Kohler Co www.kohler.com		95% recycled cast iron, w/disposal chute leading to organic waste bucket	9-15-01 No longer manufacturing this?
	WATER SAVING	Bathroom faucets	Omni Products		800-447-4962 no web page available		Reduce faucet water flow by 27% non-areator technology	Most facets have a 5 gal/min flow. New rules mandate 2.2 gpm @ 60psi, Check out dual flush control, super low flush:liquids, regualr for
		Shower heads and facets	ETL Low Flow Showerheads	Universal Spa AE 2001	Energy Technology Labs 800-638-5863 www.savewater.com	1.6 gpf now mandated	Works on as little as 3 psi but gives effective spray on 1.5 gpm	Most Shower heads use 5 to 10 gal per minute - Not good
		Shower heads and facets	Niagra Conservation Products	The Earth Showerhead	Niagra Conservation 800-831-8383 HQ=New Jersey	$5.00 each + shipping	New rules require 2.5 gpm @ 80 psi	www.niagraconservation.com
		Water-saving low flush toilet	Kohler	Wellworth	Kohler Co 888-361-8000 www.kohlerco.com		Most toilets use 3 - 5 gpf which is 40% of the residential water usage in the USA. New rules 1.6 gal/flush	According to EBN, this model is the consistently top performing 1.6 gal/flush on the market.
*			Toto				1.6 gall / flush	
*		Water-saving dual-flush toilet	Caroma USA, Inc. (562) 439-9224	Caravelle 305	Caroma USA website Darrell Rasell rep drasell@caromausa.com www.caromausa.com	$280	Choice of 0.8 gallons or 1.6 gallons per flush, saves even more water. Very well-engineered unit that works.	
*		Miscellaneous Water Saving devices	Cotton's World of Water	Variety of water saving devices available on line	www.iSaveWater.com or Cottonswow.com	Very reasonably priced		Variety of water conservation kits for retrofits
			Aquasaver		www.aquasaver.com			
*	WATER FILTRATION	Central water filtration system	Several, incl. Culligan		Several local	$285 installed	Filters impurities in drinking water.	Two stage: particulate / scale (uses paper & rope filter) and taste / odor / organic (activated carbon)
	Electrical and Lighting Fixtures							
*	Light Fixtures	CFL ceiling mounted						
	Airtight Junction boxes							
*	Ceiling Fans	Efficient Ceiling Fans	Hunter Co.		Home Depot??	$75		
*	Digital Clock Thermostat		Hunter Co.	AutoTemp				

Appendix B3.a: How Much Energy Do We Consume ?

How much energy do we consume?

A Note on average demand loads for Single Family Households in the USA

It is generally difficult for Americans to relate to the amount of energy and resources we use and how much those resources really cost us. We are 5% of the world's population but we consume 35 to 40% of the world's resources. The amount of energy used by **one** American over the course of a year is equal to the amount of annual energy used by 14 Chinese people or 531 Ethiopian peoples. Each of us, as with most living things, need energy to stay warm, fresh potable water, and fresh, clean air in order to live. But in the United States of America we certainly use more than our fair share and in fact, waste a great deal.

Energy consumption is not just about the actual fuels used but also how the burning of those fuels contributes to Greenhouse Gas Emissions, global climate change, poor air quality leading to pulmonary and heart related health concerns. Burning one gallon of gas can release as much as 20 pounds of carbon into the air. An automobile driven about 15,000 miles per year will generate an amount of carbon equal to the weight of the average 4 door automobile, or about 2.5 tons!

Helping homeowners to understand the link between understand how much energy and water we use, what we really need and what we waste on average through the course of a day, month or year is an important piece of the Green Building Template. We do not readily see the connection between our use of these resources, their cost or the capabilities of the natural systems to replenish themselves. Unless there is a crises or a dramatic jump in energy prices, Americans are ill equipped to understand the magnitude of managing and supplying our resources and then consequently, how to correct or improve the condition. To that end, the GBT offers a brief outline of current, USA wide AVERAGE uses so that future home owners can see the difference that the selected GBT energy and resource conserving appliances, mechanical, electrical, and plumbing systems and fixtures will provide. Most of energy comes from non-renewable fossil fuels, the burning of which are causing greater and greater health consequences and degradation to the environment and atmosphere.

The good news for the typical Baltimore Rowhouse occupant is that less energy and water is consumed because the homes are smaller, with less exposed surface area (walls and roofs) and fewer bathrooms than the "average" American single family detached home. Most of the "average use" estimates quoted in the GBT are based on the average American family of 2.56 members, (2.42 in Baltimore City) and living in a 2,250 gross square feet house of 3 bedrooms and 1 ½ baths. Most houses are wood framed, detached, single family structures (62.2% in US), one story, with a pitched roof covered with shingles. (1)

Home Grown Money

Saving money through home energy savings is easy! Knowing how you and your home use energy helps understand how to save energy. The KEY to energy savings lies in paying attention to the little things. Taking small steps throughout the home adds up to BIG SAVINGS. The median money income for a US household according to the 2000 Census was $37,000 dollars. In Baltimore City the median income is $27,700.

The average American household spends between $1200 and $2400 on heating, cooling, electricity and water/sewer use each year. The GBT offers suggestions that can yield savings of 30% to 70% depending on the level of energy measures included. For an average family a savings of even $500 per year is significant and if invested at 4.5% rate per year for 5 years will yield a sum of $ 2,283! Or the utility savings can help contribute toward and energy efficient mortgage as described in Section 5 or go for groceries, medical expenses, college tuition, etc.

POWER – ELECTRICITY

Residential energy consumption is significant. We use approximately 10,000 kWh of energy per household per year.

FUEL – Natural Gas

The average home uses 175 therms of energy per year or 17.5 million Btus.
The average car, driven 15,000 miles per year getting an average of 22 miles per gallon ends up consuming about 852 therms of energy per year. One gallon of gas = approximately 1.25 therms.

Appendix B3.a: How Much Energy Do We Consume ?

WATER CONSERVATION

This will be discussed in more detail in Section 3C but after fuel, the next biggest resourced used in single family households is that of clean, potable water. The average household in the Chesapeake Bay watershed uses between 75 and 100 gallons of water per day per person (US Census 2000). We only need about 4 gallons a day to survive and perhaps about 30 gallons to match our current style of living.

For a family of four, this is an annual consumption rate of over 100,000 gallons per year of potable water for internal domestic use only. This does not include outdoor irrigation, watering, gardening or pool usage, nor does it include indirect commercial or industrial uses of water that might be used by a family such as for the water needed in production of building supply materials. As a comparison, an average sized backyard, in-the-ground pool holds about 18,500 gallons of water. Approximately half of all water used within the home flows through the Bathroom.

Appendix B.3b: Bioclimatic Chart and Human Comfort

Appendix B3.2 The Bioclimatic Chart

The Bioclimatic Chart describes the effect of air temperature, humidity, MRT, wind and sunshine as shown in Figure ____ (Source: US Department of Energy).

Explanations of the chart graphical components are as follows. The air temperature is plotted on the vertical axis and relative humidity on the horizontal axis. The shaded area near the center of the graph shows the combination of temperature and humidity that most humans would find comfortable during the summer if they were sitting in the shade. The dotted area shows the comfort zone for the winter. It is interesting to see that the human body can actually adjust somewhat to different seasons.

The climatic elements around the comfort zone are shown by means of curves which indicate the nature of corrective measures necessary to restore the feeling of comfort at any point outside the comfort zone. For any point of known dry-bulb temperature and relative humidity which falls within the boundaries of the "comfort zone," no corrective measures are needed.

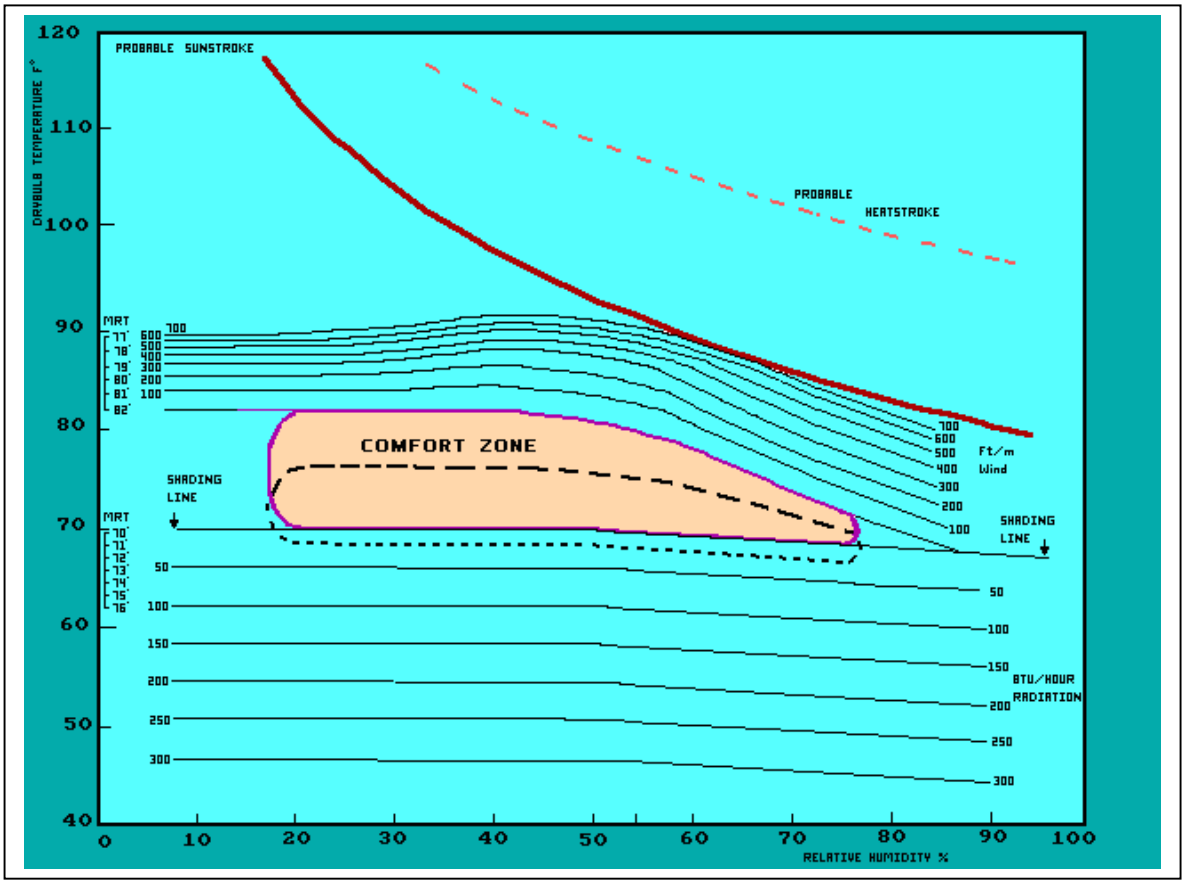
For example, at dry-bulb temperature, 73°F, relative humidity of 50%, no corrective measures are needed because this point falls within the comfort zone.

At dry-bulb temperature, 78°F, relative humidity of 70%, it would require a wind speed of about 250 FPM to provide comfort (similar to a fast-running ceiling fan, for example).

At dry-bulb temperature of 50°F, relative humidity of 55%, it would require 250 Btu/hr of sunshine to provide comfort (like sitting in a passive solar "sun-room" of a home).
Figure ____ The Bioclimatic Chart

Appendix B.3b: Bioclimatic Chart and Human Comfort

The governing national consensus standard for determining human comfort in buildings is the ASHRAE Standard 55, Thermal Environmental Conditions for Human Occupancy. Standard 55 is often used as design criteria to ensure appropriate thermal conditions. A good thermal design addresses environmental and seasonal considerations for dry-bulb temperature and radiant temperature profile, relative humidity, and occupants' activities and modes of dress. (ASHRAE: American Society of Heating, Refrigerating and Air-conditioning Engineers, Atlanta, GA USA)



APPENDIX B.4: What to look for in Appliance Selection

"Green" APPLIANCE Selection

The following is a summary of items that you should consider for energy efficient appliances and a xerox list of the most energy efficient appliances from the ACEEE *Consumer Guide to Home Energy Savings*. In general look for "Energy Star" labels and purchase the most energy efficient model you can afford for all appliances. Color should be white or almond.

Refrigerators (This and HWH highest energy use in home)

- Buy top or bottom freezer, self-defrosting model. Avoid side by side units. Freezer on bottom is slightly more efficient and loses less cold air when open;
- 16-20 cu. ft. size are generally the most energy efficient models;
- Avoid automatic ice-makers and thru-the-door features;
- Refrigerators listed on the chart are 15% more efficient than the min. required by law;
- Make sure refrigerators fit with a 1" air space on all enclosed sides;
- Operate refrigerator with thermostat at 36E to 38EF, freezer at 0E to 5EF;
- Purchase model with energy or power save switches and run with energy save or power save switch ON.

Freezer

- Chest freezer is more energy efficient than upright, but harder to organize;
- Select manual defrost as this model does not dehydrate food as badly. Defrost 2x per year is usually OK;
- Keep freezer full for better performance.

Dishwasher

- 80% of energy use goes to heating the water. 140E is common temperature, but 120E will suffice;
- Look for variable load settings (avg. DW uses 7 to 10 gallons of water per load);
- Look for energy saving settings - like air dry;
- Wash only full loads and pack the dishes efficiently according the mfg's recommendation.

Stove/Oven

- Conventional self-cleaning oven is more efficient, but only clean 1x per month;
- Exposed coil electric stoves heat up fastest, but ceramic glass cook-tops are more efficient (and more expensive to purchase initially). Ceramic glass requires flat bottomed pans for best cooking;
- Range Hoods should be vented to the outside;
- Microwave ovens cook small quantities of food very efficiently, but should be wiped out after each use for more efficient operation;
- Purchase unit with window to minimize opening the oven for checking on food while baking.

Clothes Washer

I. 90 % of energy use goes to heating the water. The average water use is 30 to 40 gallons of water per large load;
II. Horizontal axis (front-loading) washers are much more efficient, but considerably more expensive. (Several major mfg's are making residential models that might be a worth looking at);
III. Wash clothes on cooler water cycles - with new detergents, this is usually acceptable;
IV. Look for a varity of energy saving and load size options;
V. Choose machine with faster spin speed - wrings more water out of product.

Clothes Dryer

I. Gas dryers are more efficient, easier on clothes, but may cost more initially;
II. Select dryer that has a dryness sensor and shuts off automatically instead of just a timer. Moisture sensors are more efficient than temperature sensors;
III. Install a dryer vent hood that blocks air infiltration (tight sealing).

Lighting

I. Use compact fluorescent lights whenever possible;
II. AVOID halogen torchieres - very inefficient and may be prone to fire hazard;
III. Try to use light detection or motion detection controls on exterior lighting;

APPENDIX B.4: What to look for in Appliance Selection

Use *Lithonia* or comparable LED operated, “Energy Star” certified, exit lights.

Appendix B References and Resources for Further Information

WEBSITES

California Integrated Waste Management Board http://www.ciwmb.ca.gov/GreenBuilding/
Includes general information on green building, with focus on recycled materials
Searchable database of recycled-content materials, organized by CSI division.

Canadian Home Builder's Association Builder's Manual http://www.buildermanual.com/
Website demonstrates a few chapters from this guidebook, which can be ordered

Home Energy Saver is a web-based tool for analyzing annual energy consumption and costs. Available through the Center for Building Science Environmental Energy, Lawrence Berkeley National Laboratory. http://homeenergysaver.lbl.gov/

NAHB Research Center http://www.nahbrc.org/
National Association of Home Builders Research Center site has many useful links to green building resources. Includes case studies, information on energy efficiency, indoor air quality, local green building programs, resource efficiency, and waste management. Also links to green builder programs nationwide.

Minnesota Sustainable Design Guide http://www.sustainabledesignguide.umn.edu/
Detailed on-line guide includes sections on strategies and performance indicators, building life cycle analysis, setting priorities and measuring performance.

The Partnership for Advancing Technology in Housing (PATH) is a voluntary initiative that seeks to accelerate the creation and widespread use of advanced technologies to radically improve the quality, durability, environmental performance, energy efficiency, and affordability of our Nation's housing. www.pathnet.org

ToolBase is a service of the NAHB Research Center, funded by private industry and HUD through the Partnership for Advancing Technology in Housing (PATH) program. This website, www.toolbase.org provides easy access to the most credible and relevant technical information available. Access information by major topic or subject or, by the subsystem of a house; or, conduct a search to find the information.

City of Austin, TX Green Builder Program Sourcebook http://www.greenbuilder.com/sourcebook/
Organized by sections: water, energy, materials, and solid waste. Also includes a green building professionals directory for the Austin area.
Green Builder Program: A Sustainable Approach profiles the city of Austin's Green Builder Program and offers suggestions on how to reduce home construction costs by conserving resources. (http://www.sustainable.doe.gov/success/gdp.shtml)

City of Portland, OR Office of Sustainable Development http://www.green-rated.org/g_rated/grated.html
Many resources to educate about and stimulate green building. Case studies, tips for details and materials, financial incentives, and other links. Also has a PDF document on "Greening Portland's Affordable Housing."

Center of Excellence for Sustainable Development, U.S. DOE website about greening affordable housing.
http://www.sustainable.doe.gov/buildings/affhousing.shtml
Excellent site has links to many articles and case studies, as well as alternative building techniques, and financing. (Some of the articles are listed below.)

WEB ARTICLES

Affordable by Design is an article that explains affordable green housing and investigates the efforts of some groups to achieve small, resource-efficient homes that are also affordable. (http://www.emagazine.com/july-august_1997/0797feat1.html)

Affordable Housing Through Efficiency explains a project in Chicago that demonstrates the benefits of superinsulation techniques as a way to help create and maintain affordable housing. (http://hem.dis.anl.gov/eehem/93/930120.html)

Habitat for Humanity International's Environmental Initiative explains Habitat for Humanity's work toward incorporating green building techniques into its affordable housing projects. (http://www.habitat.org/env/)

Overview: Resource Efficient Buildings discusses the benefits of green buildings, how they accomplish resource efficiency and affordability and their importance in the community structure. (http://www.nrg-builder.com/greenbld.htm)

Smart Growth for Neighborhoods: Affordable Housing and Regional Vision is a report from the National Neighborhood Coalition that explores ways to strengthen links between affordable housing, smart growth, and neighborhood revitalization. (http://www.neighborhoodcoalition.org/hsg report copy2.pdf)

BOOKS

No Regrets Remodeling: Creating a Comfortable, Healthy Home that Saves Energy, c. 1997, *Home Energy* Magazine. To order: 510-524-5405 or www.homeenergy.org
Focus is on common-sense, practical techniques such as air sealing, insulation, ventilation, moisture control, and using the sun. Includes a primer on the basics of moisture behavior in building, information about heating, cooling, hot water, and lighting equipment, as well as the synergistic effects of the various elements in a home.

Eco-Renovation: the Ecological Home Improvement Guide, by Edward Harland, c.1993. Chelsea Green Publishing Company, also available from Real Goods.
Sections on space planning, energy efficiency, health, and materials. Also has resources for further information.

GENERAL GREEN BUILDING PROGRAMS AND SUPPORT

US Green Building Council
Kristen Ralff Douglas, Managing Director
110 Sutter St., Suite 906
San Francisco, CA 94104
415-445-9500, 9911 fax
(Developed LEED rating program for commercial buildings, residential LEED in development, 2000 - 2001)

Global Green USA
Lynn Simon,
Program Manager
227 Broadway, Suite 302, Santa Monica, CA 90401
310-394-7700, 7750 fax, E-mail lnsimon@aol.com
(Develop various green building initiatives throughout US)

EDUCATION, BAY POLICY, AND
GROWTH MANAGEMENT SERVICES

Maryland Department of Natural Resources

Tawes State Office Building, E-2

Annapolis, MD 21401

410.260.8710

E-Mail: dnrsmartgrowth@dnr.state.md.us

www.dnr.state.md.us/smartgrowth/greenbuilding
www.energy.state.md.us

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